DELTA BUILDING DIVERSION

AT MYRTLE GROVE (BA-33)

ALTERNATIVE MODELING

Prepared for

Louisiana Department of Natural Resources

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EXECUTIVE SUMMARY

Alternative modeling was performed for the proposed ***Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Delta Building Diversion at Myrtle Grove*** project. The numerical model developed and documented in the Moffatt & Nichol August 2005 report to the Louisiana Department of Natural Resources titled "Barataria Basin: Hydrodynamic & Salinity Model Development," was used for this study. The diversion at Myrtle Grove will be another large freshwater diversion project in the Barataria Basin in addition to the existing, and currently operating, Davis Pond diversion.

Some modifications were made to the original model grid to increase resolution in the vicinity of the Myrtle Grove diversion and to eliminate one discharge boundary condition where limited data was available. Additionally, rainfall runoff from areas within the basin not included in the model grid was added.

A simulation time period of one calendar year was chosen to assess the alternative plans. This simulation period is from August 2002 to July 2003 which included the two primary model calibration periods discussed in the aforementioned report when extensive data collection efforts were undertaken. It should be noted that two tropical storms (Isidore and Lili) directly impacted the basin during late September and the beginning of October 2002, while Tropical Storm Bill impacted the basin at the end of June and beginning of July 2003.

For this alternative modeling study, four different Myrtle Grove diversion scenarios were modeled in conjunction with three appropriate diversion regimes at Davis Pond as shown in the following table. In addition, "existing" condition runs with only nominal diversions at Myrtle Grove and Davis Pond, and scenario runs with double-high Myrtle Grove diversion and high Davis Pond diversion were also performed.

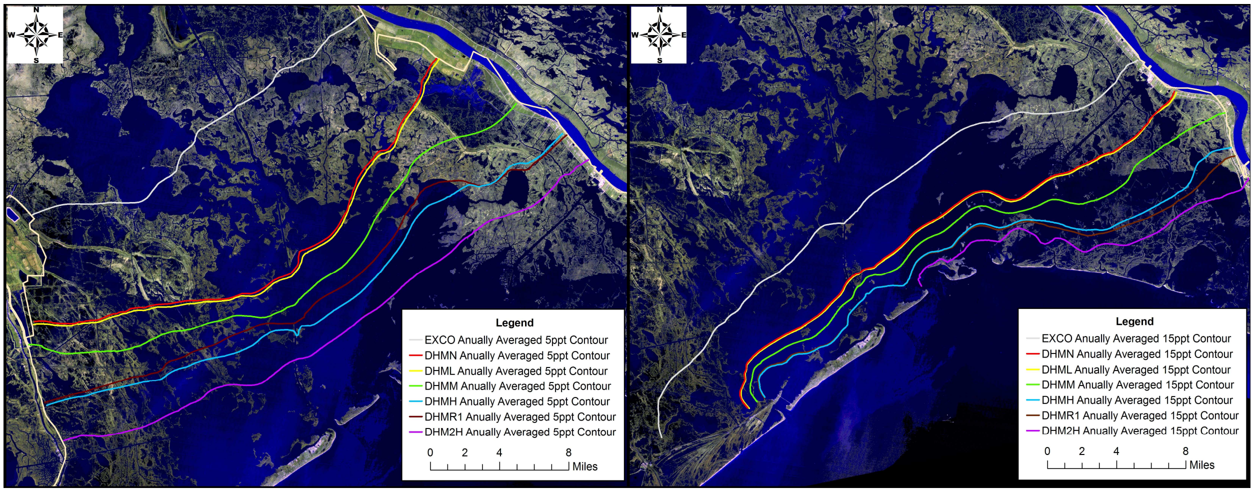
Discharge Time Series at the Diversions (cfs)

Month	Davis Pond Diversion				Myrtle Grove Diversion				
	Existing	High	Medium	Low	Existing	High	Medium	Low	R1
Jan	Nominal 10	8,000	6,000	4,000	Nominal 10	16,500	5,300	10	19,881
Feb		10,560	7,920	5,280		18,300	6,400	10	33,063
Mar		10,560	7,920	5,280		19,500	7,700	10	39,546
Apr		10,560	7,920	5,280		19,420	7,500	10	39,546
May		10,560	7,920	5,280		19,200	7,000	10	39,546
Jun		10,560	7,920	5,280		18,950	4,800	10	10
Jul		6,000	4,500	3,000		14,840	3,300	2,500	10
Aug		4,000	3,000	2,000		9,740	3,300	1,500	10
Sep		4,000	3,000	2,000		9,550	3,000	10	10
Oct		4,000	3,000	2,000		9,400	3,000	1,000	10
Nov		6,000	4,500	3,000		9,330	3,000	1,000	10
Dec		8,000	6,000	4,000		12,900	4,000	10	19,881

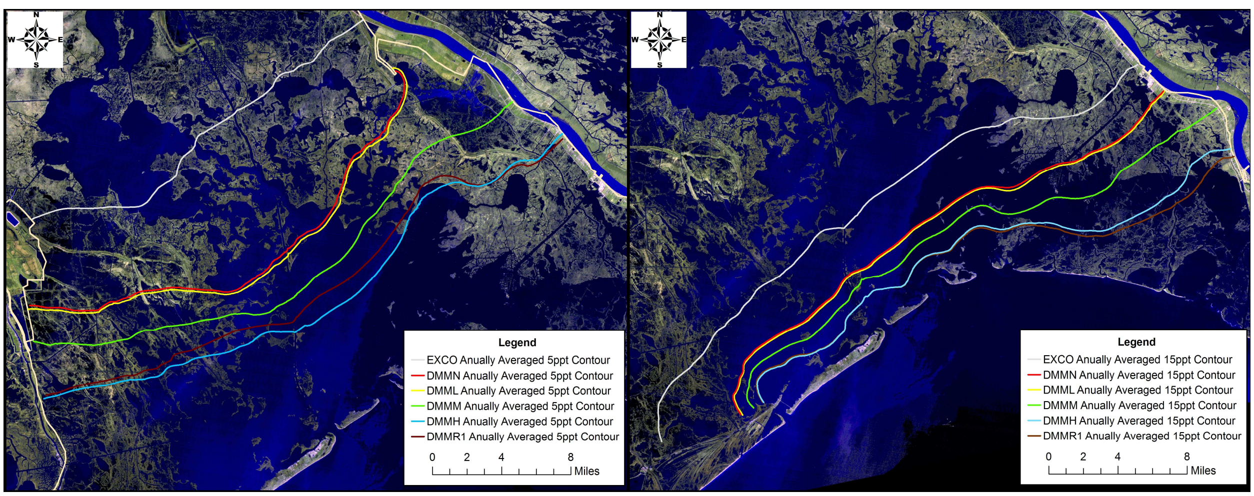
Note: The medium and high flows for the Davis Pond diversion are computed as 150% and 200%, respectively, of the corresponding low flows; for Myrtle Grove diversion R1, the monthly discharges are the maximum values.

The following figures present the impact of the proposed Myrtle Grove diversions on the 5 ppt and 15 ppt salinity contours in the basin on an annually averaged basis for the 2002-2003 time frame modeled.

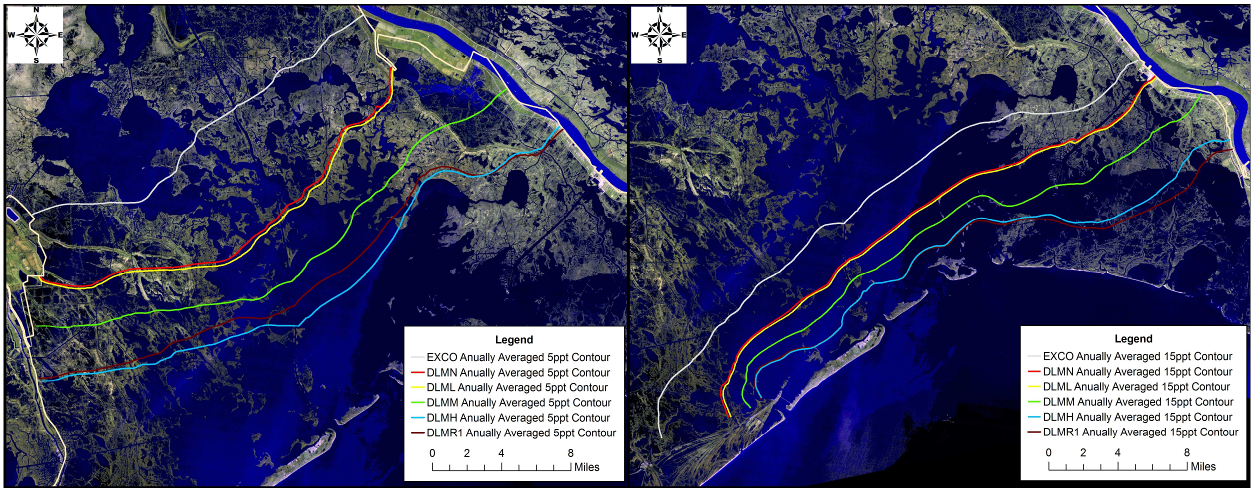
These figures indicate that if a high Myrtle Grove diversion is used, the 5 ppt and 15 ppt contour lines retreat to south by about 4 miles and 1.5 miles, respectively more than no Myrtle Grove diversion under a high Davis Pond diversion rate. The retreats would be about 4.5 miles and 2 miles under a medium Davis Pond diversion, and increase to 6 miles and 2.5 miles under a low Davis Pond diversion. However if a medium Myrtle Grove diversion is used, the retreats would reduce to about half the distance of high Myrtle Grove diversion case, while the low Myrtle Grove diversion shows little impact on the salinity levels in the basin. For the R1 diversion case at Myrtle Grove, the annually averaged 5 ppt contour lines retreat to south less than the high Myrtle Grove cases, and the 15 ppt contours are close to the high Myrtle Grove cases. The reason is that there are no diversions from June to November. For the double-high Myrtle Grove diversion case, both the 5 ppt and 15 ppt contours retreat more to the south.



Annually Averaged Contour Changes under High Davis Pond Diversion Rate for different Myrtle Grove Diversions

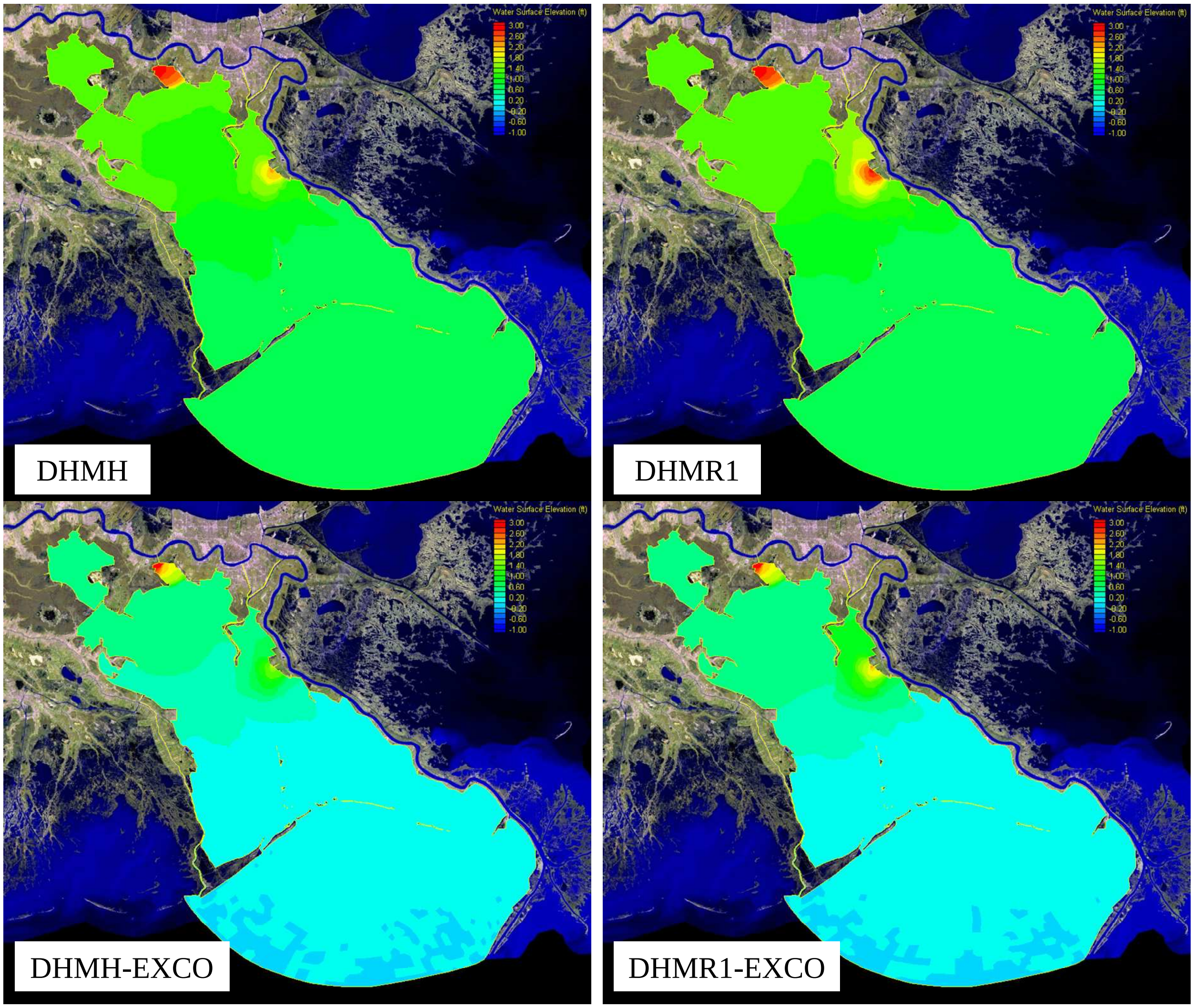


Annually Averaged Contour Changes under Medium Davis Pond Diversion Rate for different Myrtle Grove Diversions

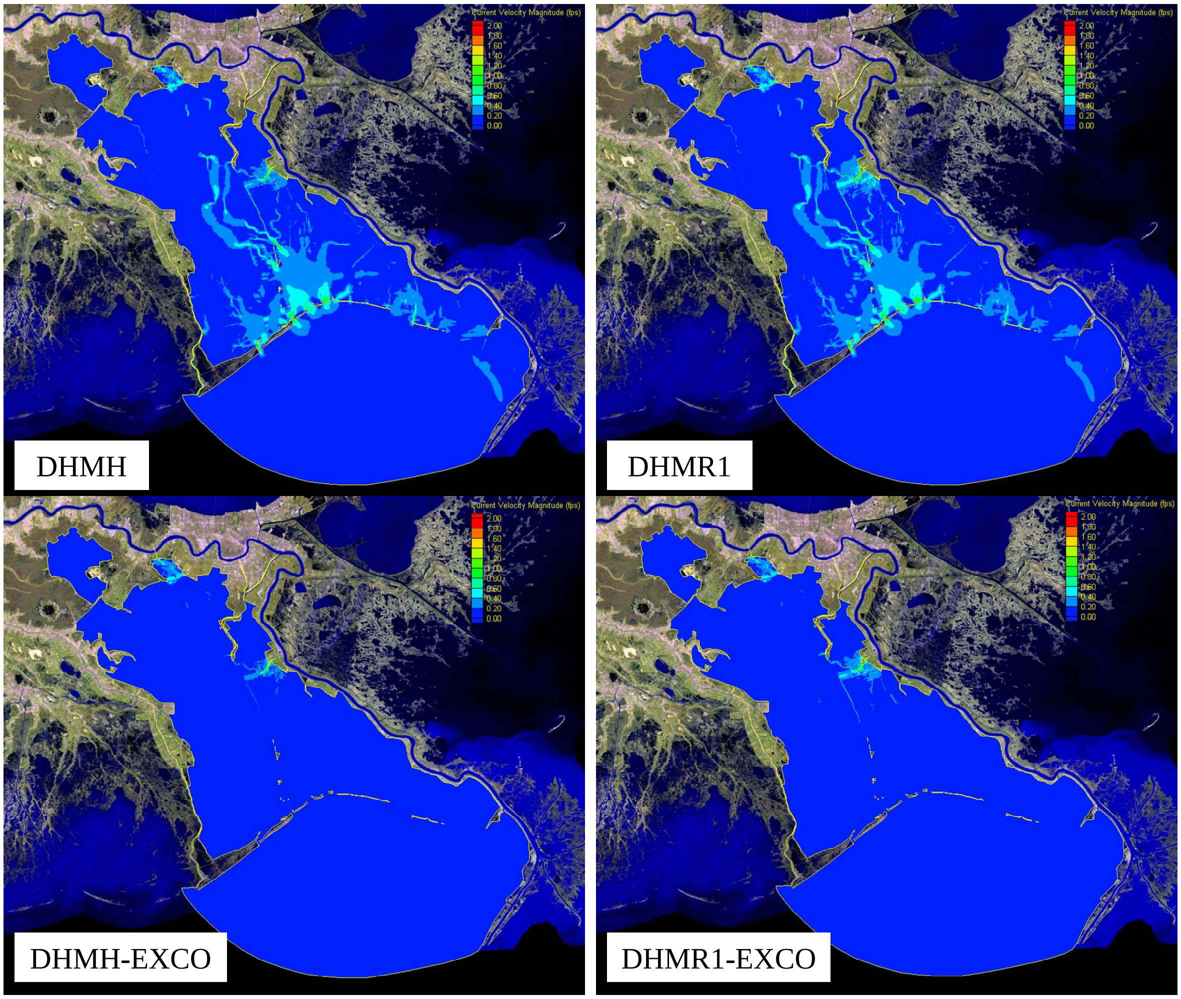


Annually Averaged Contour Changes under Low Davis Pond Diversion Rate for different Myrtle Grove Diversions

The hydrodynamic results from two Myrtle Grove diversion cases, DHMH and DHMR1, were examined on a semi-annual average basis (December – May). It was found that these higher diversions caused significant increases of both the water surface elevation and current velocity magnitude near the region adjacent to the project sites. The following figures present the semi-annually averaged hydrodynamic results. The annually and semi-annually averaged hydrodynamics results from 17 different locations throughout the basin were also extracted and compared for all 16 scenario model runs. The results confirm the above observations.



Semi-Annual Averaged Water Surface Elevation – DHMH & DHMR1



Semi-Annual Averaged Current Velocity Magnitude – DHMH & DHMR1

Analyses and review of the alternative modeling results lead to the following conclusions:

- The impacts on salinity levels in the Barataria Basin from the Myrtle Grove project depend on the diversion regimes at Davis Pond. The effects of the Myrtle Grove project are reduced under higher Davis Pond diversion scenarios.

- The Myrtle Grove project under low diversion has negligible impact on salinity levels in the Barataria Basin regardless of the Davis Pond Diversion operational level.

- High Myrtle Grove diversions could reduce annual average salinity levels over 6 ppt depending upon the magnitude of diversions at Davis Pond while medium Myrtle Grove diversions would only reduce the annual average salinity by less than 4 ppt.

- The high Myrtle Grove diversion scenario would push the annual 5 ppt and 15 ppt salinity level contours twice as far southward as the medium Myrtle Grove diversion case; regardless of the magnitude of the different Davis Pond diversion.

- On a semi-annual (December – May) basis, the R1 and double-high Myrtle Grove diversion scenarios push the 15 ppt salinity line to near the backside of the barrier islands except in the immediate vicinity of the passes, and the far eastern section of the basin.

- From a hydrodynamic point of view, on average, the larger diversions from Myrtle Grove and Davis Pond cause significant water surface elevation and current magnitude increases in the region adjacent to the sites.

Recommendations include:

- The Low Myrtle Grove diversion scenario is not an effective option to reduce salinity levels in the Barataria Basin and should not be considered further.

- The Medium Myrtle Grove scenario only has minimal effects on salinity levels and may not be cost effective.

- The High Myrtle Grove diversion scenario is effective at reducing salinity levels, albeit less so when higher diversions occur at Davis Pond.

- Higher diversions such as the R1 and double-high scenarios should be given further consideration due to their significant potential impacts on reducing salinity levels throughout the Barataria Basin.

- The Myrtle Grove diversions do not significantly impact areas southeast of Port Sulphur, and thus additional diversions in the vicinity of Port Sulphur, Empire and Fort Jackson would be necessary to reduce salinities in this area.

- Further investigation is warranted to determine if the increases in water levels and current velocities results from the higher diversion are within acceptable limits, and /or what operational restrictions may be required if they are not acceptable.

1. INTRODUCTION

This is a supplemental report following the Moffatt & Nichol August 2005 report to Louisiana Department of Natural Resources (LDNR) titled as "Barataria Basin: Hydrodynamic & Salinity Model Development." As a continuous effort to facilitate future planning efforts in the basin, Moffatt and Nichol (M&N) was retained by LDNR to perform alternative modeling for the ***Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Delta Building Diversion at Myrtle Grove***. This will provide the ability to more completely evaluate the effects of proposed projects on a basin-wide scale.

Delta Building Diversion at Myrtle Grove (BA-33) will be another large freshwater diversion project in the Barataria Basin in addition to the Davis Pond Diversion project. The Myrtle Grove Diversion project would involve installation of gated box culverts on the west bank of the Mississippi River in the vicinity of Myrtle Grove; dedicated dredging from the Mississippi River to create marsh in the vicinity of Bayou Dupont, the Barataria Bay Waterway, and the Wilkinson Canal; or a combination of these actions. Supporting features might include a conveyance channel with parallel mainline flood control levees and an outflow channel with guide levees. Dredging to create adequate outfall in the headwaters of Bayou Dupont and construction of a pump station may be required. The size of the project area is about 416,563 acres with a total estimated cost of $144.3 million. Without remediation, it is anticipated that approximately 14,500 acres of wetlands will be lost in the project area over the next 20 years and that wetland types will continue to shift towards more saline habitats.

This report describes the modeling process and methodology with respect to the Myrtle Grove project, including discussion of the input data, assumptions made, boundary conditions used, simulation time periods, calibration/verification, and alternative plan modeling results.

2. HYDRODYNAMIC AND SALINITY MODEL DEVELOPMENT

2.1 GENERAL DESCRIPTION

The 64-bit RMA program code was obtained from the USACE. This code now includes the ability to account for rainfall in the salinity model (RMA-4) for a grid of the size created for the Barataria Basin which the old model code could not handle. Model runs were made with the new code and successfully compared with previous model runs. Thus, the new code was used for the Myrtle Grove project.

2.2 MODEL GRID

The offshore area of the model domain has been extended at its southwest corner to encompass the outlet of the Bayou LaFourche channel. This extension has the advantage of rendering the previous open water boundary at the outlet of the Southwest (SW) Canal (near Leeville) redundant since it is now part of the model domain, a move prompted by the dearth of flow data at SW Canal for the entire simulation period. The Bayou LaFourche channel is extended northward until just before GIWW consistent with the location of an existing lock there that interrupts its interaction with the channel further north.

A total of 10 new open water boundaries have been created in the upper basin to allow freshwater inflow from the catchment areas of Lac des Allemands (6), Lake Cataouatche (2) and the northeast end of GIWW (1) as recommended in the Barataria Basin Report (Moffatt & Nichol, 2005) as well as the diversion at Myrtle Grove. As was the case at GIWW and Davis Pond, these boundaries have been set up as 1-D elements that then interface with the adjoining 2-D elements in the model domain. The local bathymetry and meshes have been refined, especially those near the Myrtle Grove diversion, to provide a smooth flow transition into the basin consistent with field conditions. The dimensions of the outlet channel from the Myrtle Grove diversion are as per the conceptual design provided by the USACE, while those at the catchment flow outlets are suitably sized to prevent super-critical flow.

As shown in Figure 2.2-1, the revised Barataria Basin model grid contains 19112 elements and 56236 nodes.

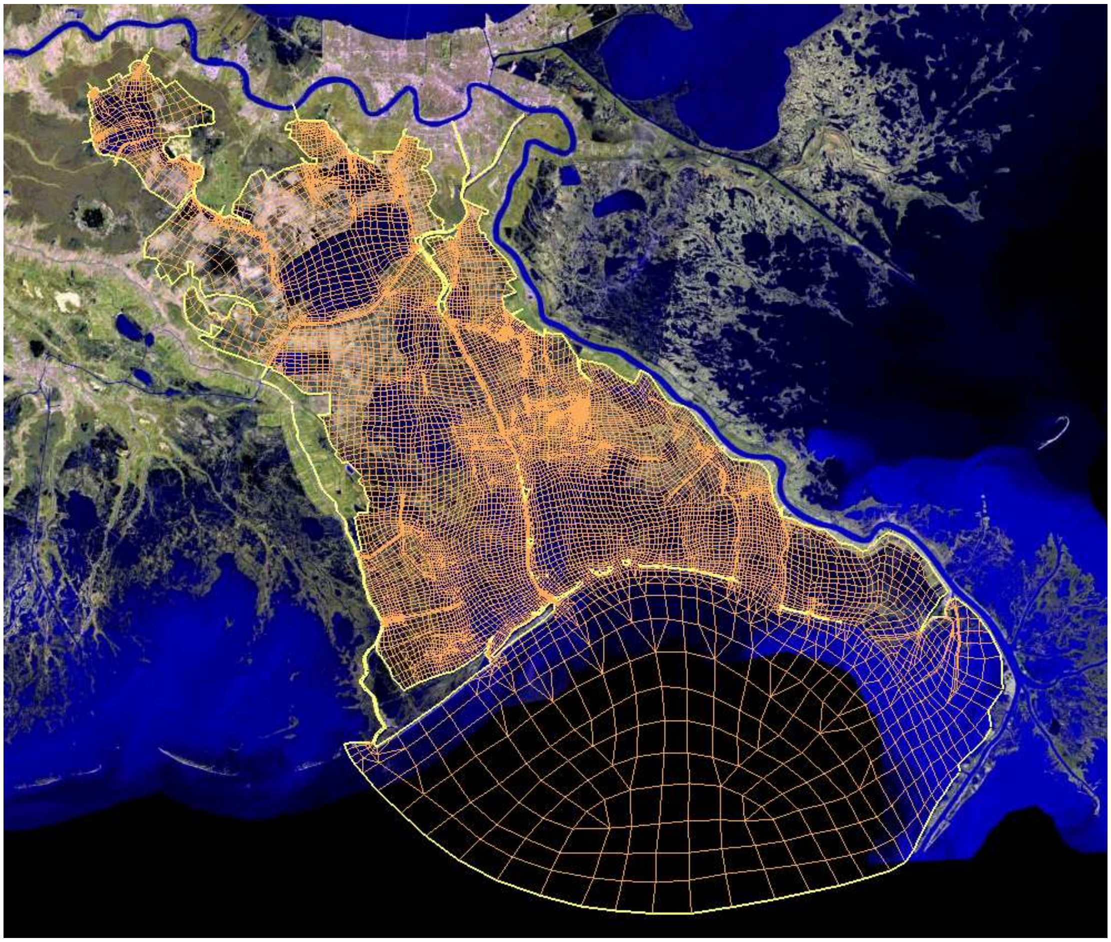


Figure 2.2-1: Revised Barataria Model Finite Element Grid

2.3 SIMULATION PERIODS

A simulation time period of one calendar year was chosen to assess alternative plans. This simulation period is from August 2002 to July 2003, including the two primary model calibration periods in the Barataria Basin Report (Moffatt & Nichol, 2005): September 15, 2002 0:00 through September 21, 2002 12:00 and from December 2, 2002 22:00 through December 10, 2002 4:00. It should be noted that two tropical storms (Isidore and Lili) directly impacted the basin during late September and the beginning of October 2002, while Tropical Storm Bill impacted the basin at end of June and beginning of July 2003. The same data sets as developed and used in the Barataria Basin Report (Moffatt & Nichol, 2005) have been extended to cover the one-year period. Since data gaps do exist, some boundary conditions were synthesized based on engineering judgments.

2.4 BOUNDARY CONDITIONS AND MODEL PARAMETERS

The boundary data required as inputs in the RMA-2 modeling comprise water level and discharge time series at the open water boundaries, and net precipitation and wind over the entire model domain. Similarly, the data sets required for the RMA-4 modeling are the same net precipitation over the model domain to capitalize on the upgraded RMA-4 code that has included the rainfall and evaporation routines on a large scale as recommended in the Barataria Basin Report (Moffatt & Nichol, 2005), and salinity time series at the same open water boundaries.

2.4.1 Hydrodynamic Boundary Conditions

The revised Barataria Basin model currently has thirteen hydrodynamic boundary conditions as shown in Figure 2.4-1. They are an open water level boundary in the Gulf of Mexico, a discharge boundary at the intersection of the GIWW with Bayou Lafourche, discharge boundaries at both the Davis Pond Diversion and proposed Myrtle Grove Diversion, and additionally nine discharge boundaries to simulation the fresh water streamflows from nine delineated runoff catchment areas in the northern section of the model domain as presented in Figure 2.4-2.

Figure 2.4-3 shows the water level boundary conditions in the Gulf of Mexico for the one year simulation period. These were developed by using the water level data gathered at gauge location BAFS-10 in Barataria Pass after applying the same datum shift and 4-hour moving average as used in the original modeling effort. No amplitude adjustment or phase change was made as it was determined that there were minimal differences in the modeled water levels at BAFS-10 as compared to the open water boundary location. Similarly, the discharge time series at the GIWW were based on the water level and velocity time series at Station 7381235/BAFS-06 using the same stage-discharge rating equation as before and subjected to 4-hour moving averaging. Figure 2.4-4 shows the discharge boundary condition at the GIWW where it intersects with Bayou Lafourche.

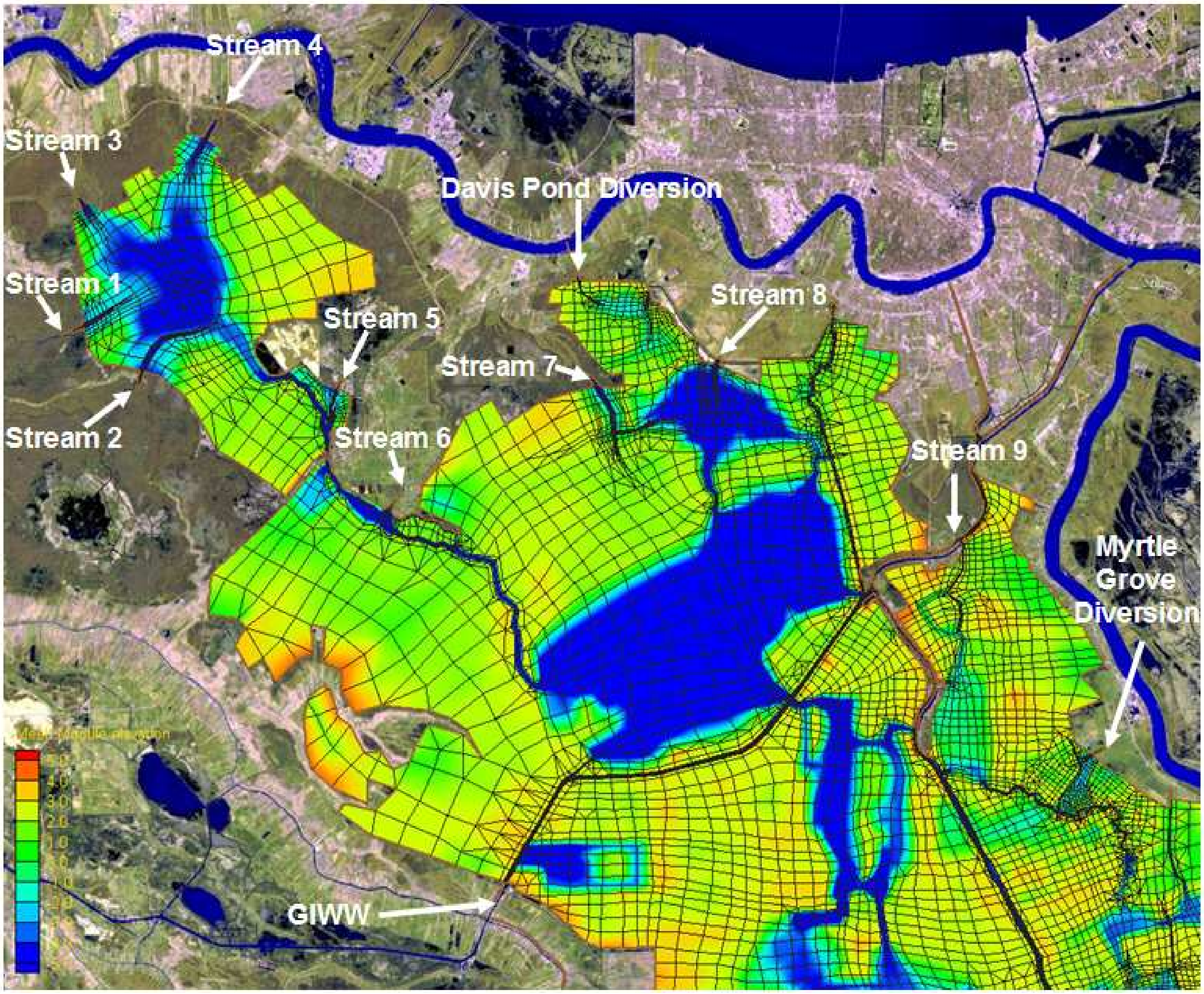


Figure 2.4-1: Barataria Model Boundary Condition Locations

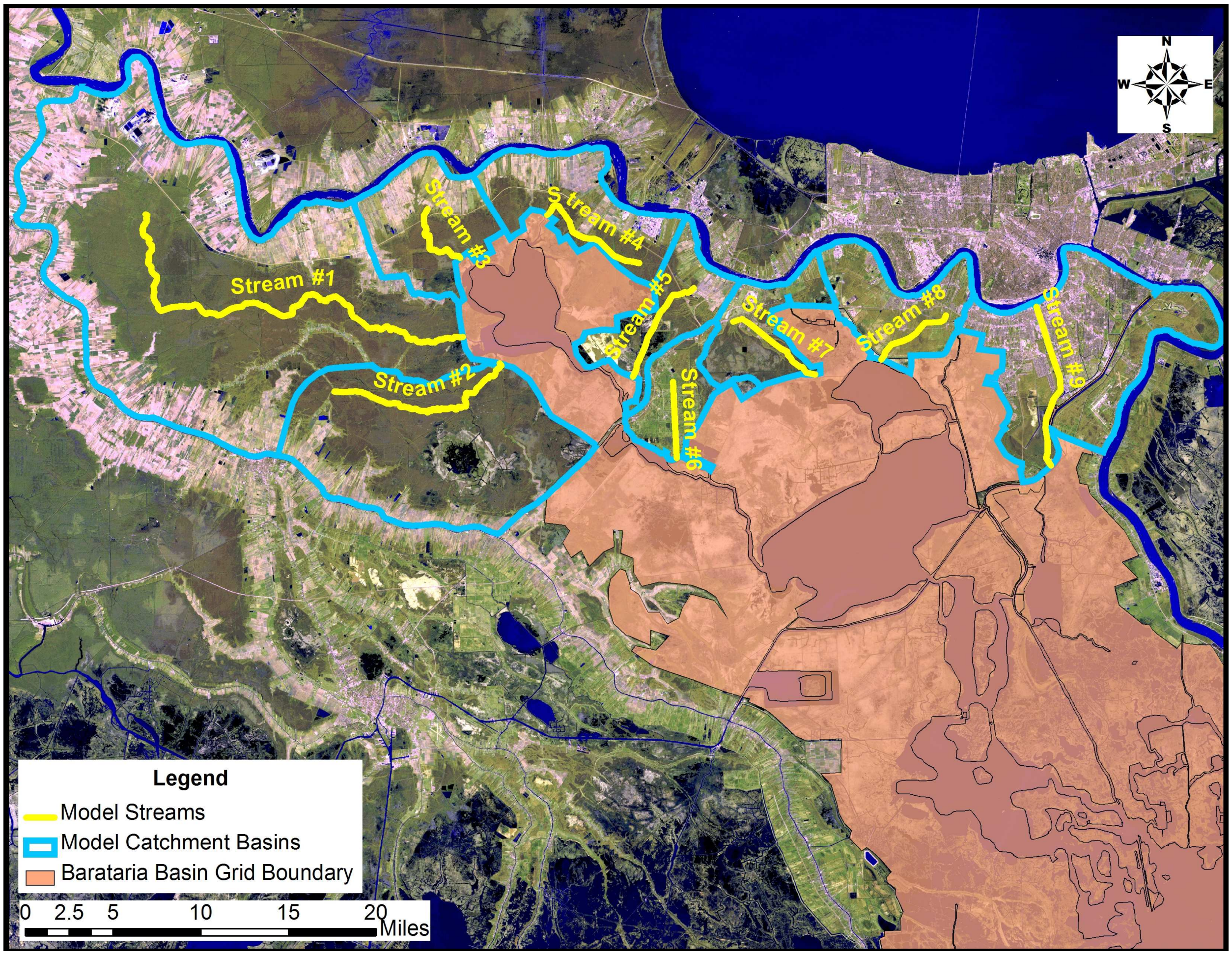


Figure 2.4-2: Runoff Catchments and Streams

For the selected pre-screening level alternative model runs, four Myrtle Grove project alternative scales were modeled in conjunction with three appropriate existing diversion regimes at Davis Pond. This resulted in a total of twelve year-long model runs.

The discharge time series at the Davis Pond and Myrtle Grove diversions provided by DNR and the USACE are summarized in Table 2.4-1 and shown in Figure 2.4-5 and Figure 2.4-6.

A nominal flow of 10 cfs was used for the no-flow conditions from January to June, September and December in the low Myrtle Grove diversion case. This nominal flow instead of zero inflow was adopted to avoid model numerical instability.

Table 2.4-1: Discharge Time Series at the Diversions (cfs)

Month	Davis Pond Diversion				Myrtle Grove Diversion				
	Existing	High	Medium	Low	Existing	High	Medium	Low	R1
Jan	Nominal 10	8,000	6,000	4,000	Nominal 10	16,500	5,300	10	19,881
Feb		10,560	7,920	5,280		18,300	6,400	10	33,063
Mar		10,560	7,920	5,280		19,500	7,700	10	39,546
Apr		10,560	7,920	5,280		19,420	7,500	10	39,546
May		10,560	7,920	5,280		19,200	7,000	10	39,546
Jun		10,560	7,920	5,280		18,950	4,800	10	10
Jul		6,000	4,500	3,000		14,840	3,300	2,500	10
Aug		4,000	3,000	2,000		9,740	3,300	1,500	10
Sep		4,000	3,000	2,000		9,550	3,000	10	10
Oct		4,000	3,000	2,000		9,400	3,000	1,000	10
Nov		6,000	4,500	3,000		9,330	3,000	1,000	10
Dec		8,000	6,000	4,000		12,900	4,000	10	19,881

Note: The medium and high flows for the Davis Pond diversion are computed as 150% and 200%, respectively, of the corresponding low flows; for Myrtle Grove diversion R1, the monthly discharges are the maximum values.

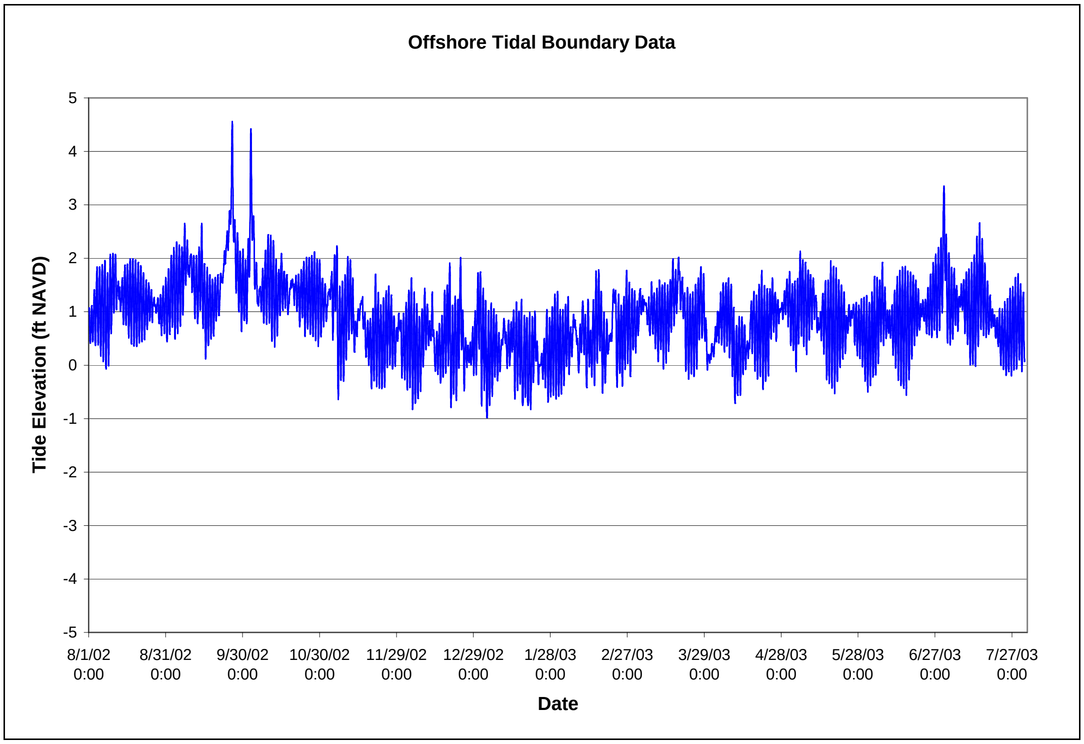


Figure 2.4-3: Offshore Water Level Boundary Conditions

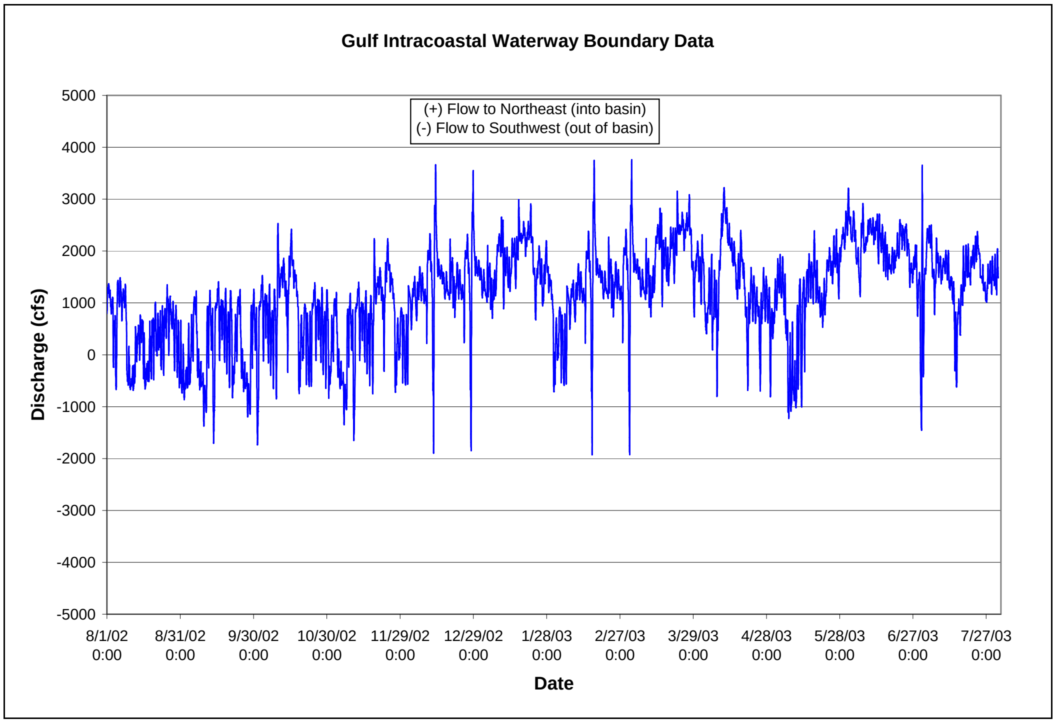


Figure 2.4-4: GIWW Discharge Boundary Conditions

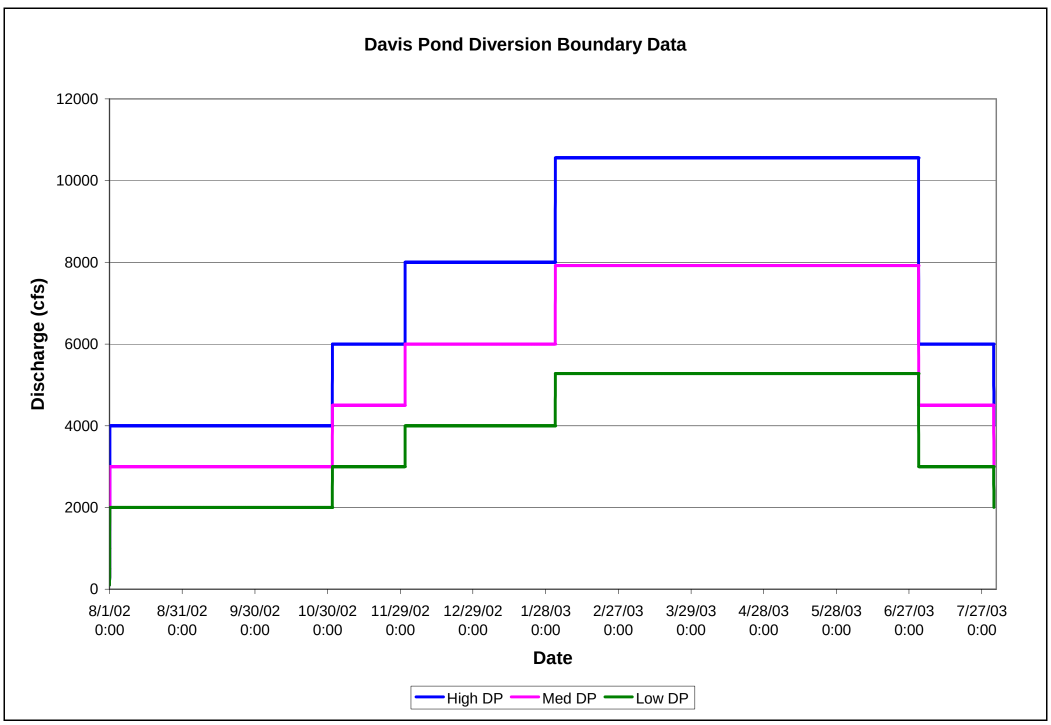


Figure 2.4-5: Davis Pond Diversion Discharge Boundary Conditions

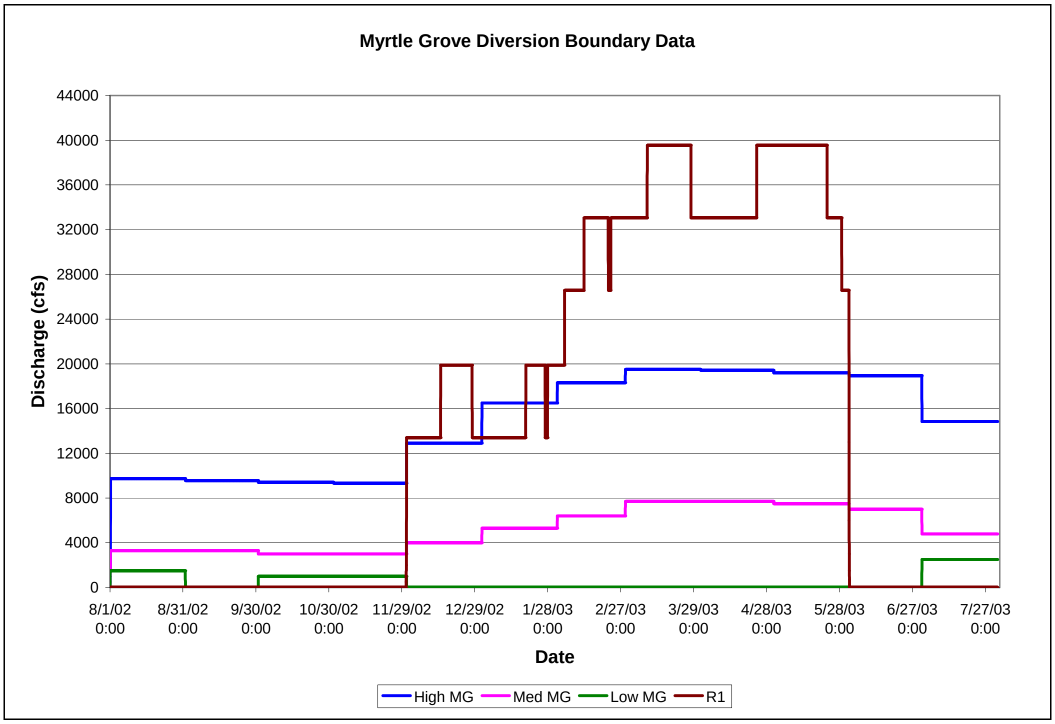


Figure 2.4-6: Myrtle Grove Diversion Discharge Boundary Conditions

Runoff enters the Barataria Bay estuarine system through a complex series of coastal swamps and wetlands, mostly from local precipitation. Using the approach from Park et al (2004) report of their hydrology-hydrodynamic model of Barataria Basin, runoff streamflow hydrographs from nine delineated catchment areas not included in the model grid were developed and inputted to the model as discharge boundaries. Figures 2.4-7 through 2.4-15 show the stream discharge time series from the runoff computation with a minimum discharge of 10 cfs. These were kept the same for all nine year-long model runs.

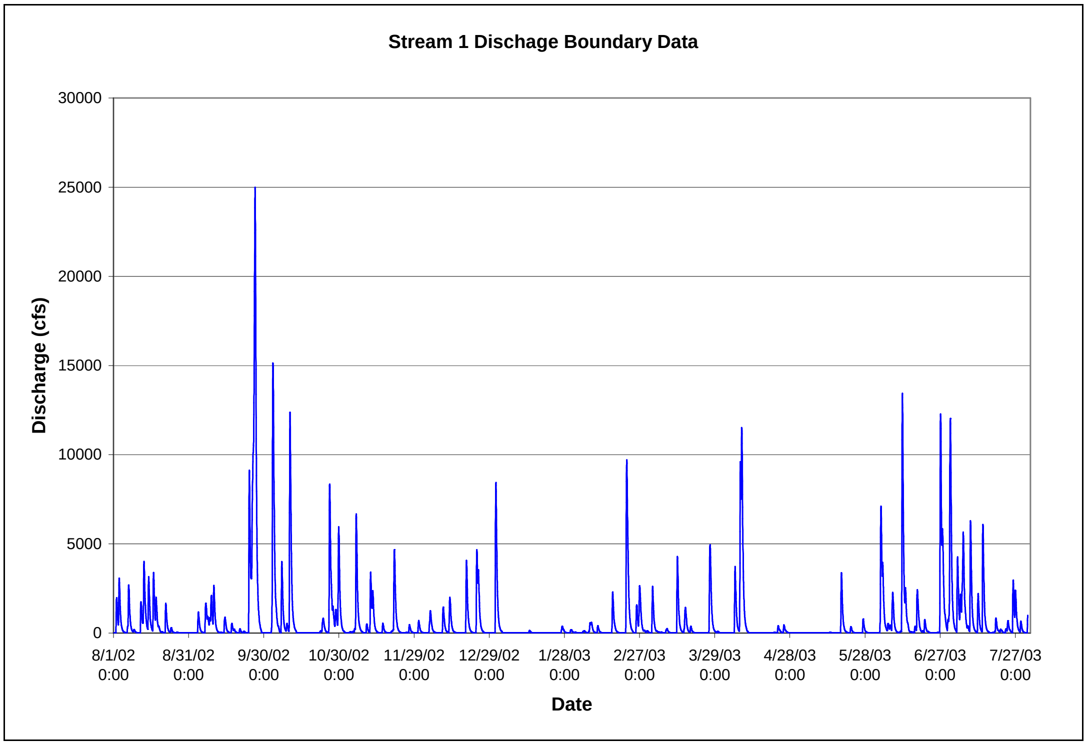


Figure 2.4-7: Stream 1 Discharge Boundary Conditions

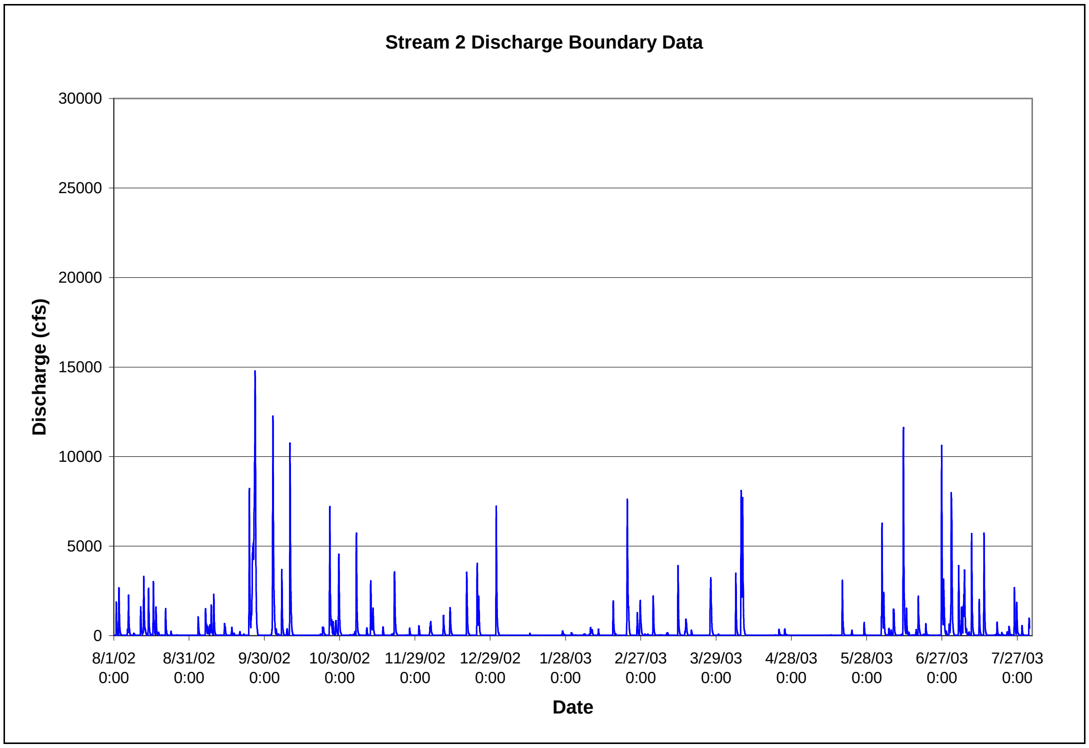


Figure 2.4-8: Stream 2 Discharge Boundary Conditions

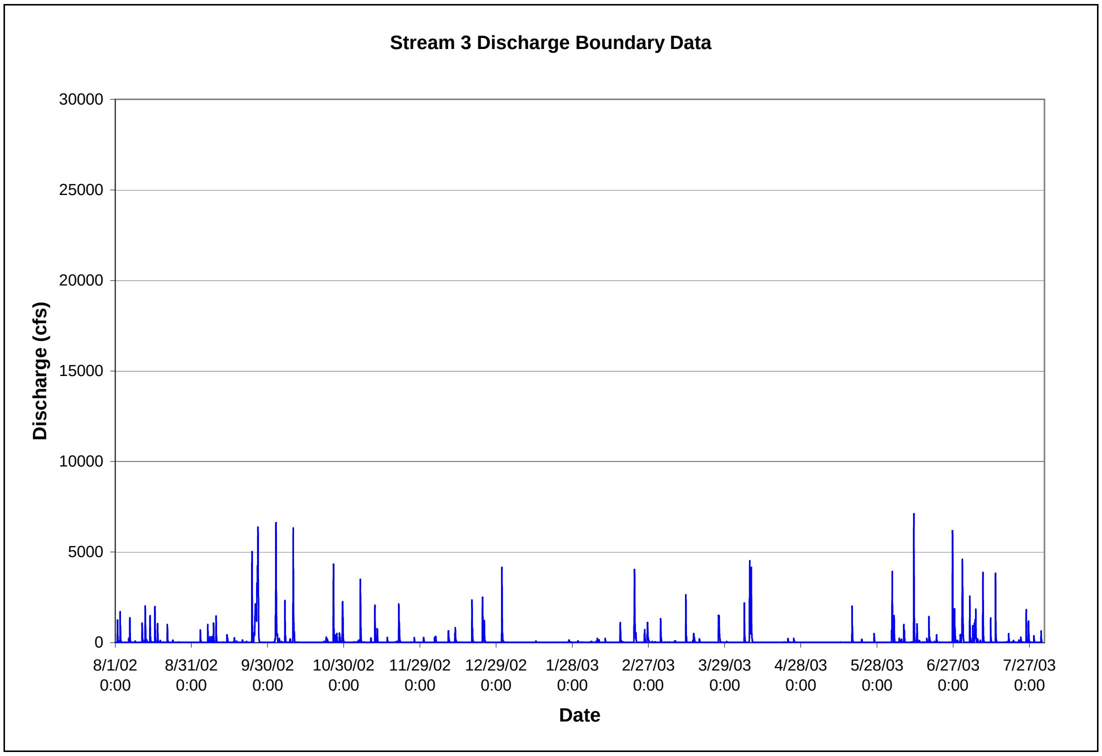


Figure 2.4-9: Stream 3 Discharge Boundary Conditions

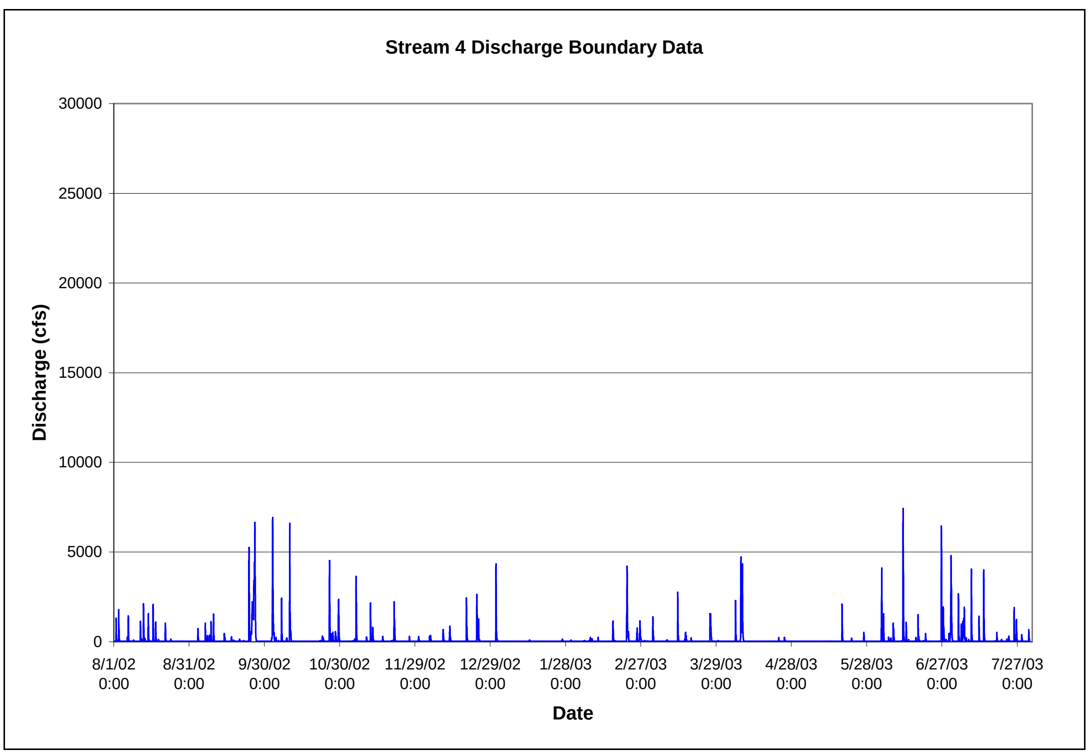


Figure 2.4-10: Stream 4 Discharge Boundary Conditions

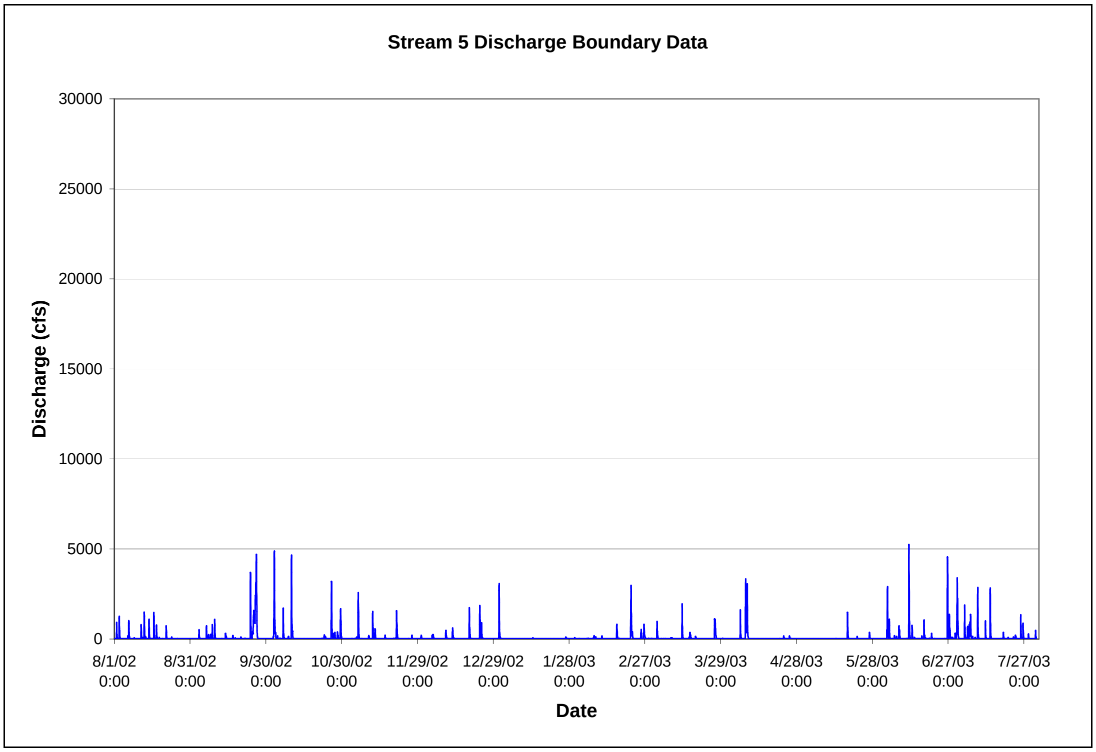


Figure 2.4-11: Stream 5 Discharge Boundary Conditions

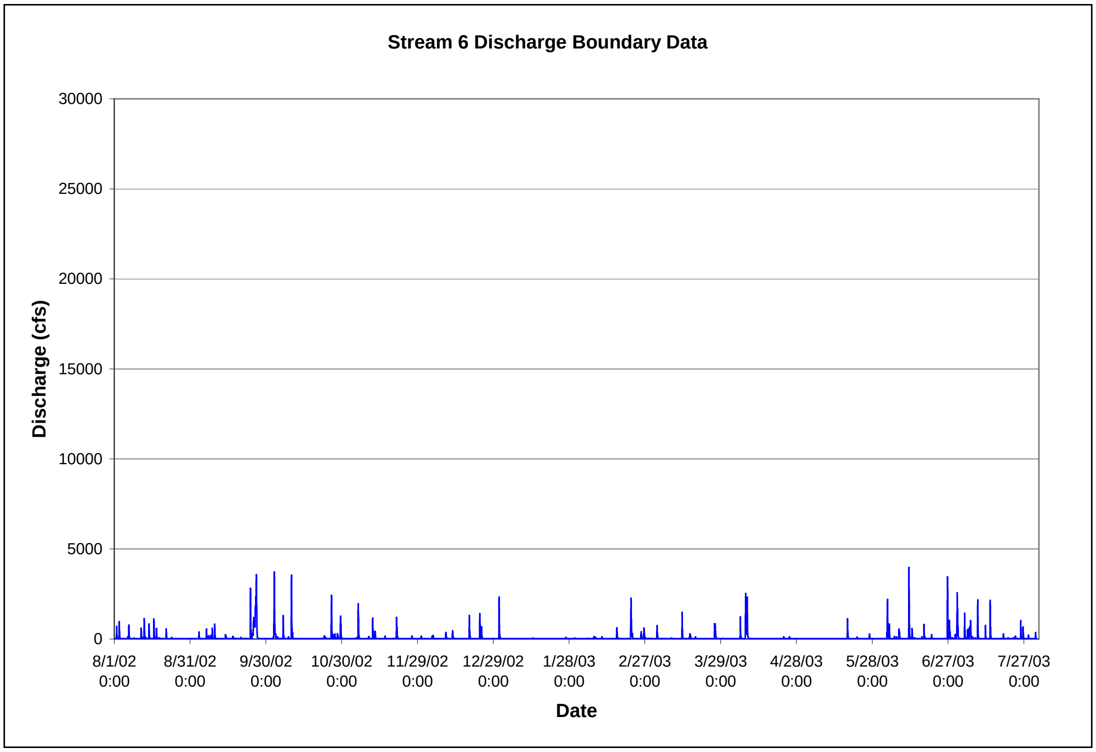


Figure 2.4-12: Stream 6 Discharge Boundary Conditions

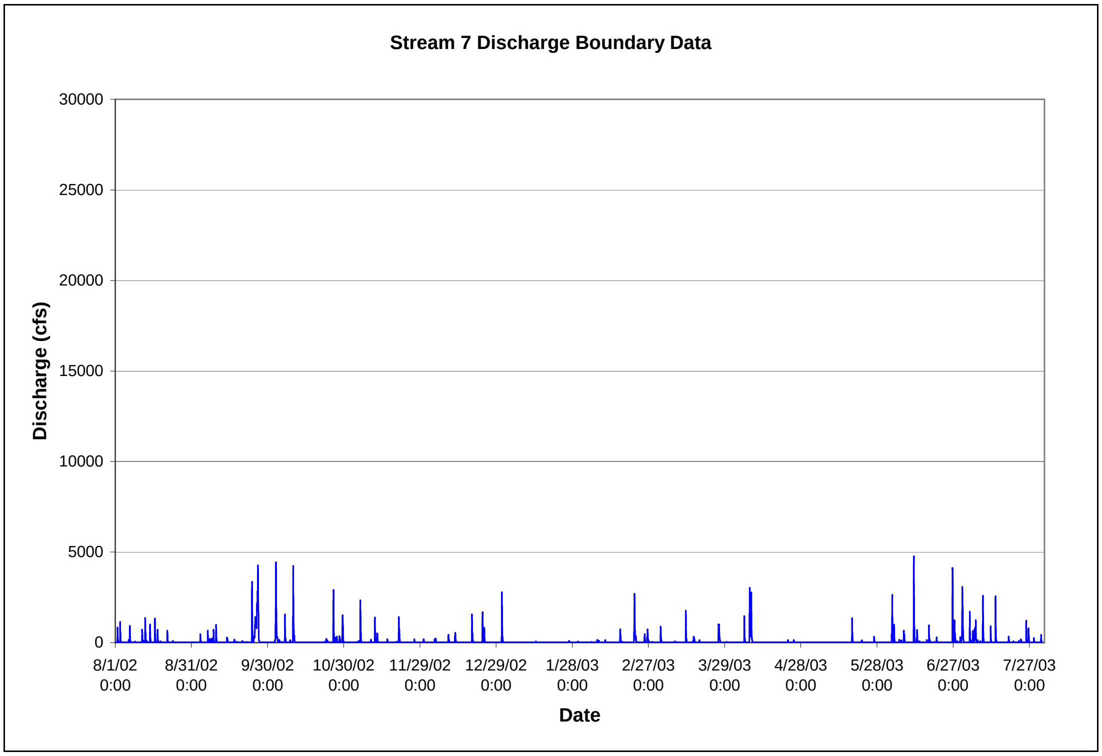


Figure 2.4-13: Stream 7 Discharge Boundary Conditions

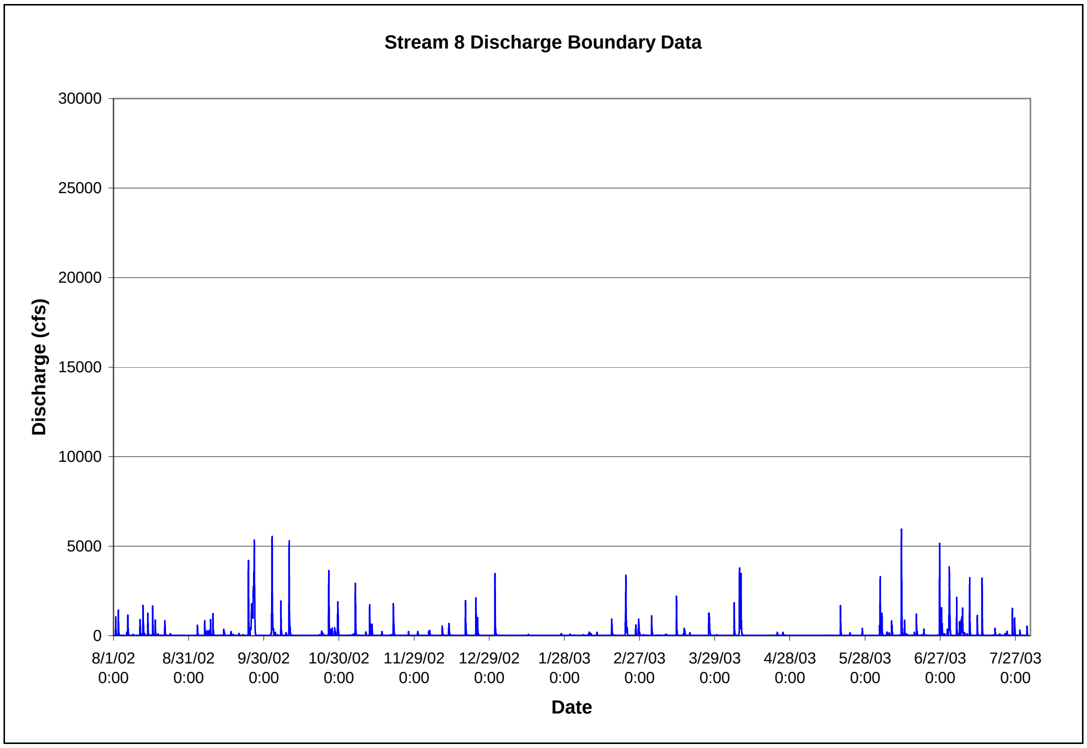


Figure 2.4-14: Stream 8 Discharge Boundary Conditions

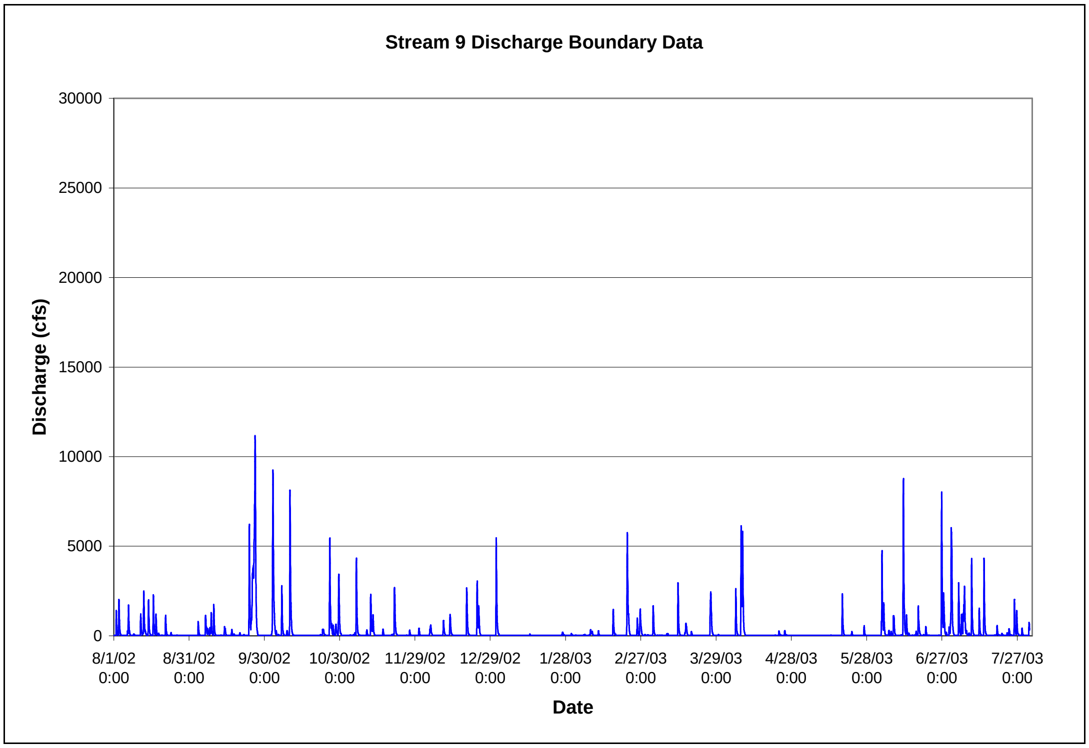


Figure 2.4-15: Stream 9 Discharge Boundary Conditions

2.4.2 Wind, Precipitation, and Evaporation Boundary Conditions

The wind distribution is based on the same zone-based approach as before where four wind stations cover the entire model domain: they being at Grand Isle (GDIL1), Boothville (161157), Lake Salvador near Lafitte (DCPBA05), and New Orleans International Airport (166660). The data gaps in the Lake Salvador wind data series were filled with data from Grand Isle for the same period, the two zones being contiguous. The same wind adjustment factors for elevation and duration as before were used. However, temperature corrections to account for the stratification effect due to cold air being heavier were made. In essence, if the underlying surface is colder than the air, the atmosphere becomes stably stratified and turbulent transfers are suppressed. If the surface is warmer than the air, the atmosphere becomes unstably stratified and turbulent transfers are enhanced (CEM, 2003). In this regard, Figure 3-14 in Shore Protection Manual (USACE, 1984), which depicts the variation of the temperature adjustment factor as a function of temperature difference between air and sea, was used. Here the empirical curve has been represented as a step-wise function listed in Table 2.4-2 to yield a year-long hourly variation, as opposed to the use of two constant values applied to the months of September and December, respectively in the previous study (Moffatt & Nichol, 2005).

Due to a lack of meteorological information for the interior area, the variation of air-sea temperature difference for the entire basin was based on the measured data at Grand Isle. The resulting wind time series were then subjected to the 4-hour moving averaging. Additionally, the maximum wind speed was capped at 20 mph (1-hour average) as previous experience has indicated that the RMA-2 code can not handle high wind events without numerical instability problems when large sections are subject to wetting and drying (even if the marsh porosity approach is used). This capping has the effect of removing episodic wind events that are of short duration, and hence are unlikely to have a significant effect on the long-term salinity regime after an extreme event during which the diversions would not be operating. Figures 2.4-16 through 2.4-19 show the wind speeds and directions used at each wind station for the August 2002 simulation period. All wind data are presented in Appendix A.

Table 2.4-2: Step-wise variation in the temperature correction factor, R_T, as a function of air-sea temperature difference

Temperature difference class, ΔT (^0C)	**R_T**
< -12	1.18
-11 to -12	1.17
-10 to -11	1.165
-9 to -10	1.155
-8 to -9	1.15
-7 to -8	1.14
-6 to -7	1.13
-5 to -6	1.11
-4 to -5	1.1
-3 to -4	1
-2 to -3	1.08
-1.5 to -2	1.06
-1 to -1.5	1.04
-0.5 to -1	1.02
0 to -0.5	0.98
0.5 to 0	0.96
1 to 0.5	0.94
1.5 to 1	0.925
2 to 1.5	0.91
2.5 to 2	0.9
3 to 2.5	0.89
4 to 3	0.87
5 to 4	0.86
6 to 5	0.85
> 6	0.84

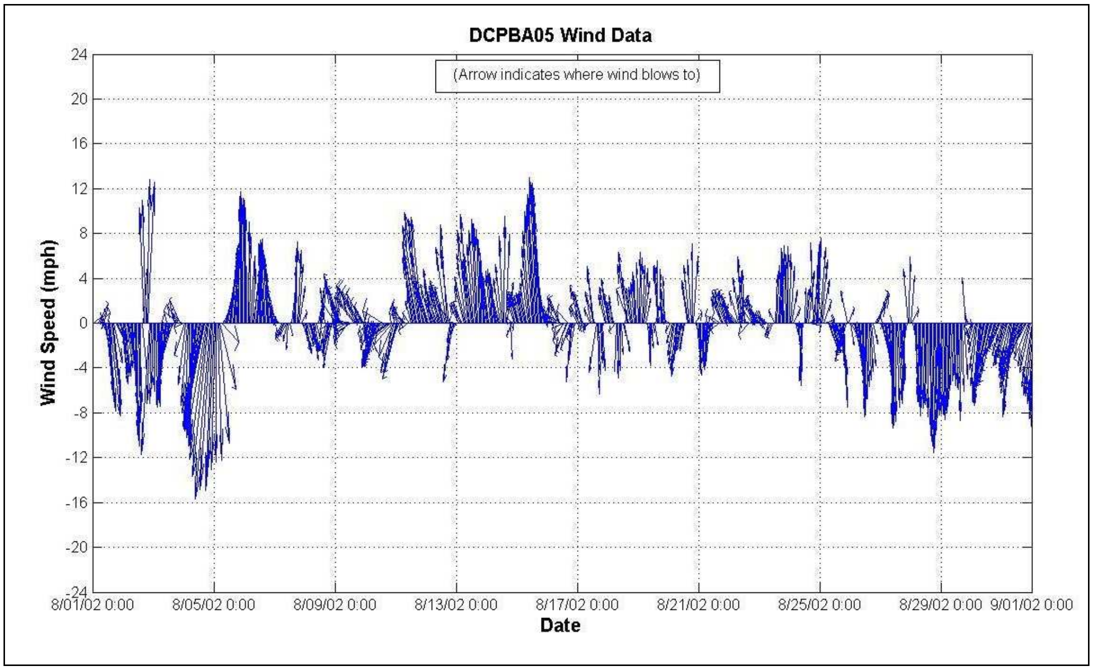


Figure 2.4-16: August 2002 Wind Speed and Direction at Station DCPBA05

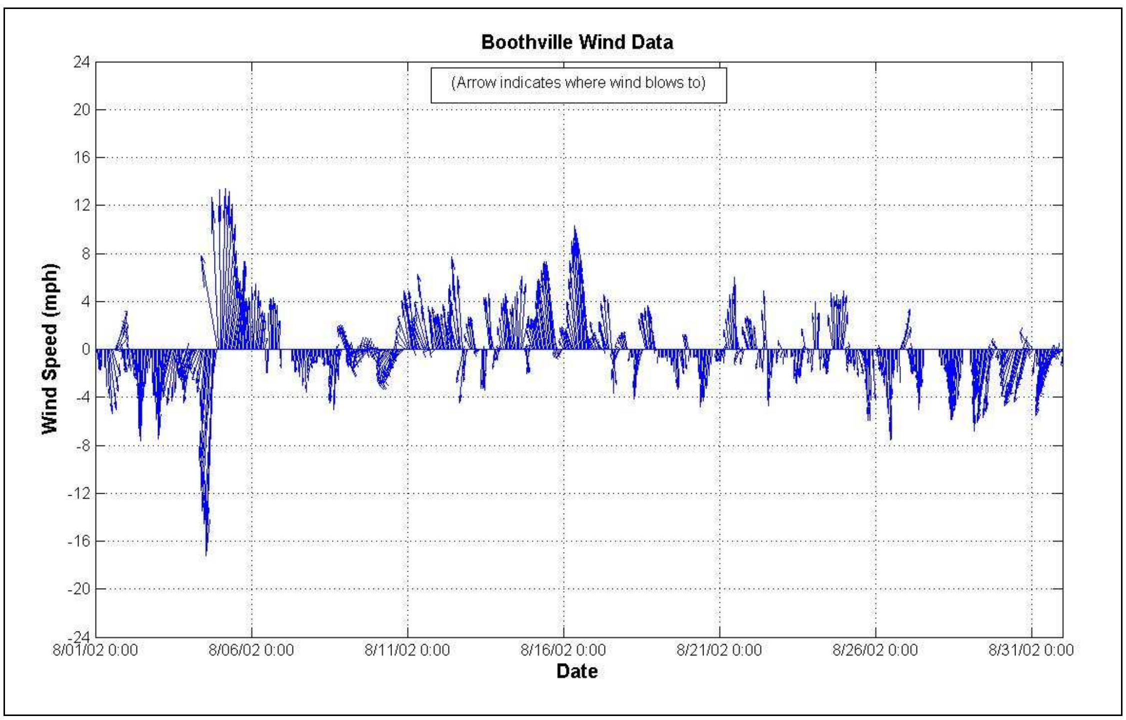


Figure 2.4-17: August 2002 Wind Speed and Direction at Station Boothville

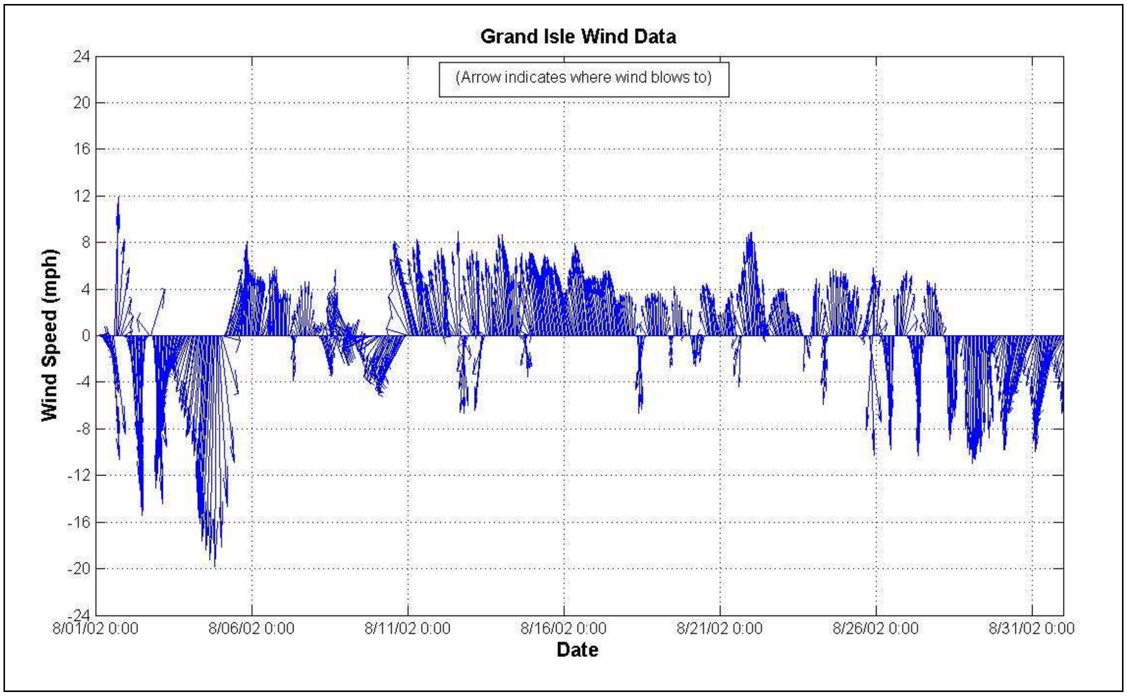


Figure 2.4-18: August 2002 Wind Speed and Direction at Station Grand Isle

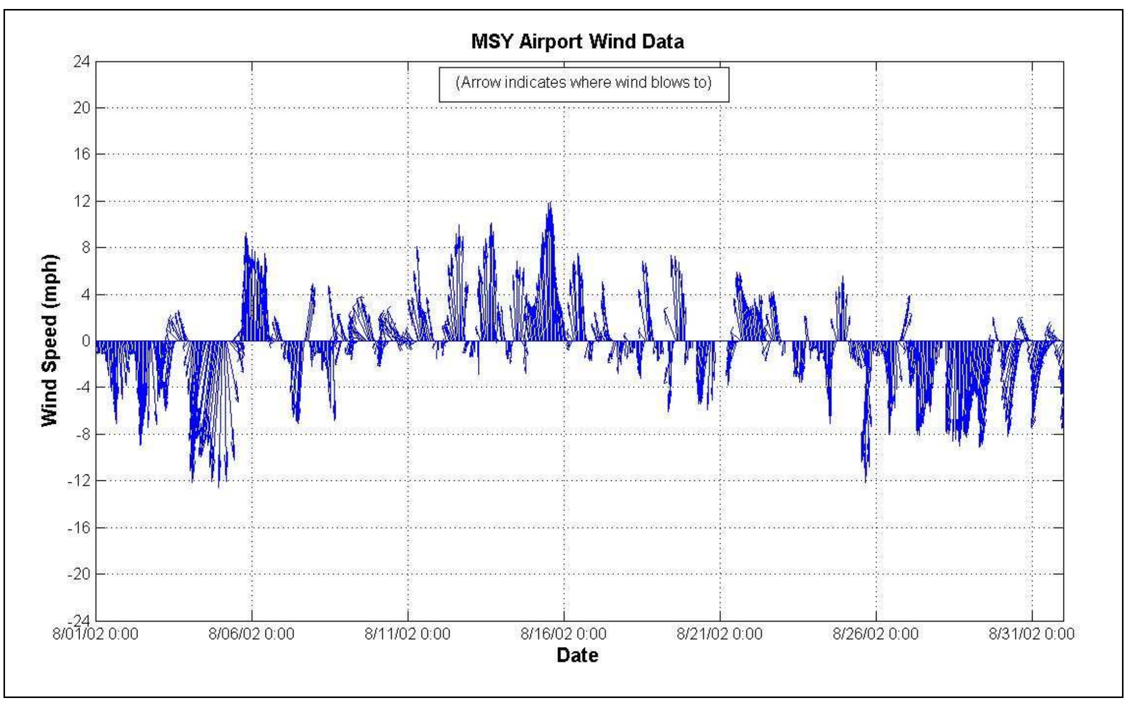


Figure 2.4-19: August 2002 Wind Speed and Direction at Station MSY Airport

The precipitation distribution is based on a similar zoned approach where the entire model domain is covered by 5 stations: Mississippi River @ Bonnet Carre Spillway (7374370), Mississippi River @ New Orleans (7374510), Mississippi River at Venice (7374550), Bayou LaFourche south of Golden Meadow (7381305), and Boothville (161157). While the previous study (Moffatt & Nichol, 2005) has employed the daily measured evaporation pan data at Houma (assumed uniformly applicable to the entire model area) as the basis to arrive at the net precipitation (precipitation – evaporation) time series used as model inputs, here it was sought to improve upon the methodology by using an analytical approach to yield the hourly evaporation data based on the zoned approach.

The bulk aerodynamic method that reduces to a set of empirical equations, which has been found to be well-developed for the Gulf coastal region (Park, 2002), was used. The same set of empirical equations as used by Park (2002) to estimate the evaporation time series at GDIL1 for 1999 has been used and reproduced below, unless otherwise stated.

In analogy to the energy transfer by turbulent diffusion from ocean to atmosphere, the latent heat flux as a result of the transfer of water vapor from the ocean to the atmosphere, H_l, can be estimated as:

$$H_l = L_T E = L_T C_E \rho (q_{sea} - q_{air}) U_{10}$$

where L_T is the latent heat of vaporization; E is the evaporation in units of kg/m^2-s; C_E is the wind drag coefficient (Note that this has been incorrectly defined as the latent heat coefficient in Park (2002), p. 18); ρ is the air density; q_{sea} and q_{air} are the specific humidity for the sea and air, respectively; and U_{10} is the wind speed at the 10m reference height.

At the sea surface, the specific humidity, q_{sea}, is related to the saturation vapor pressure, e_{sea}, through (Hsu, 1988):

$$q_{sea} = 0.62(e_{sea}\, p^{-1})$$

where $e_{sea} = 6.1078 \times 10^{[7.5T_{sea}/(237.3 + T_{sea})]}$, p is atmospheric pressure in units of HPa (mbar), and T_{sea} is the sea surface temperature (^{0}C).

Similarly,

$$q_{air} = 0.62(e_{air}\ p^{-1})$$

where $e_{air} = 6.1078 \times 10$^[$7.5T_{dew}/(237.3 + T_{dew})$], and T_{dew} is the dew-point temperature (^{0}C).

Also, the parameter values as used by Park (2002) are adopted: $C_E = 1.12 \times 10^{-3}$, ρ=1.2 kg/m^3, and a latent heat flux of 1 W/m^2 being equivalent to an evaporation rate of 3.56 x 10^{-3} cm/day, except for $L_{T,}$ which is taken as 2.5 x 10^6 J/kg (Note that the value in Park (2002) is one-order of magnitude less at 2.5 x 10^5 J/kg) as consistent with the value in May (1996, p.1.21, at 15^{0}C).

Thus the evaporation rate as computed above becomes a function of air and dew temperatures, atmospheric pressure at the sea surface, and the wind speed. The time series data for the air and dew temperatures and the atmospheric pressure are taken from the Grand Isle station and deemed representative of the entire model domain. The wind data are based on the measurement at the four wind stations discussed above, but unsmoothed (instantaneous hourly readings) and uncapped. Since there is overlap in the precipitation (5) and wind (4) zones, the computed evaporation rates are applied to the precipitation zones in the manner summarized in Table 2.4-3. The net precipitation is then computed as the difference between the measured precipitation and the computed evaporation rate on an hourly basis. Figures 2.4-20 through 2.4-24 show the net hourly precipitation for the precipitation stations used for the one-year simulation periods.

Table 2.4-3: Evaporation zones

Precipitation Zone	Applied Evaporation Zone (based on wind)
7374370	Average of 16660 and DCPBA05
7374510	16660
7381305	Average of DCPBA05 and GDIL1
161157	Average of GDIL1 and 161157
7374550	161157

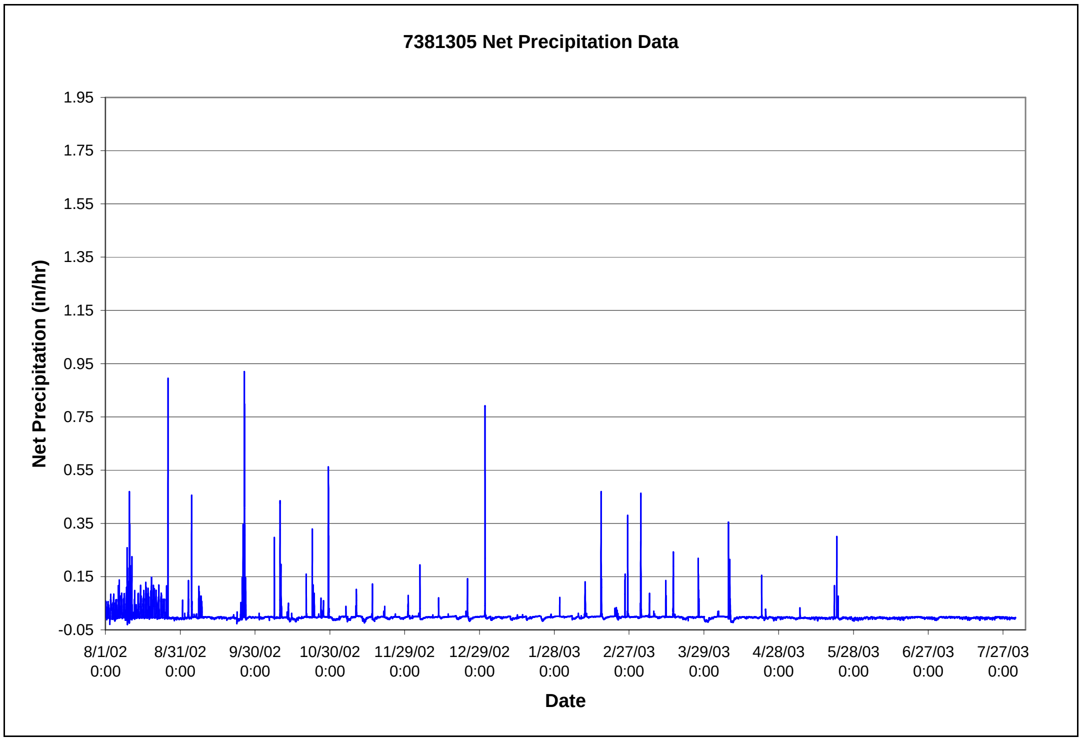


Figure 2.4-20: Net Precipitation Data at Station 7381305

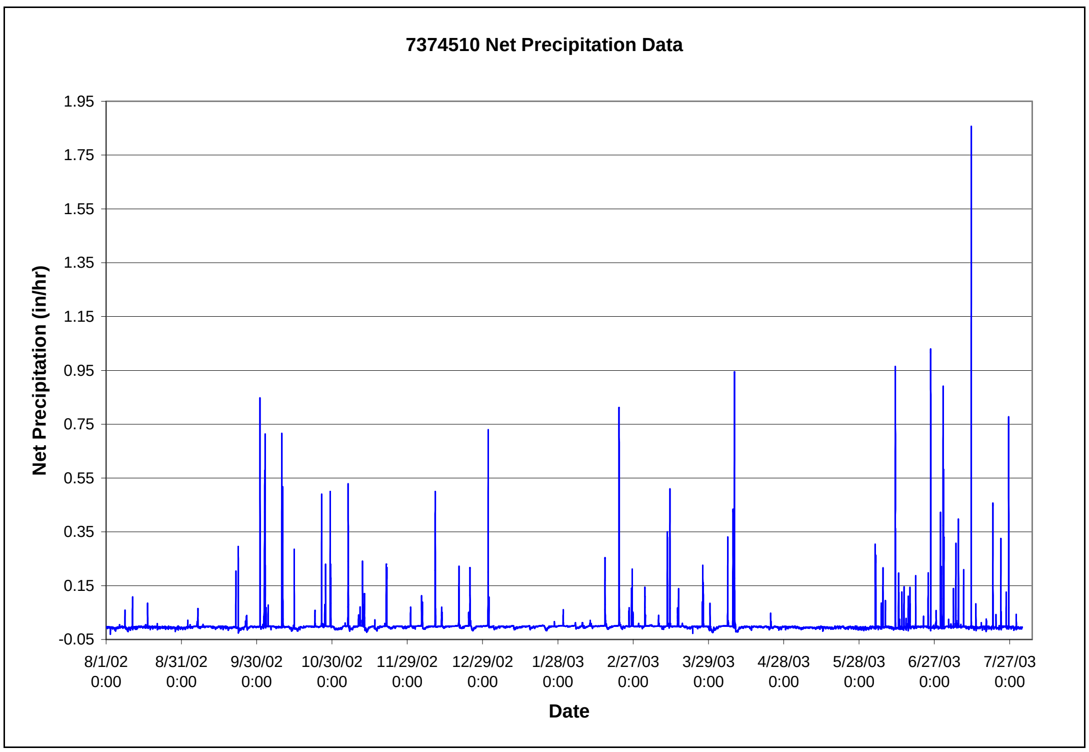


Figure 2.4-21: Net Precipitation Data at Station 7374510

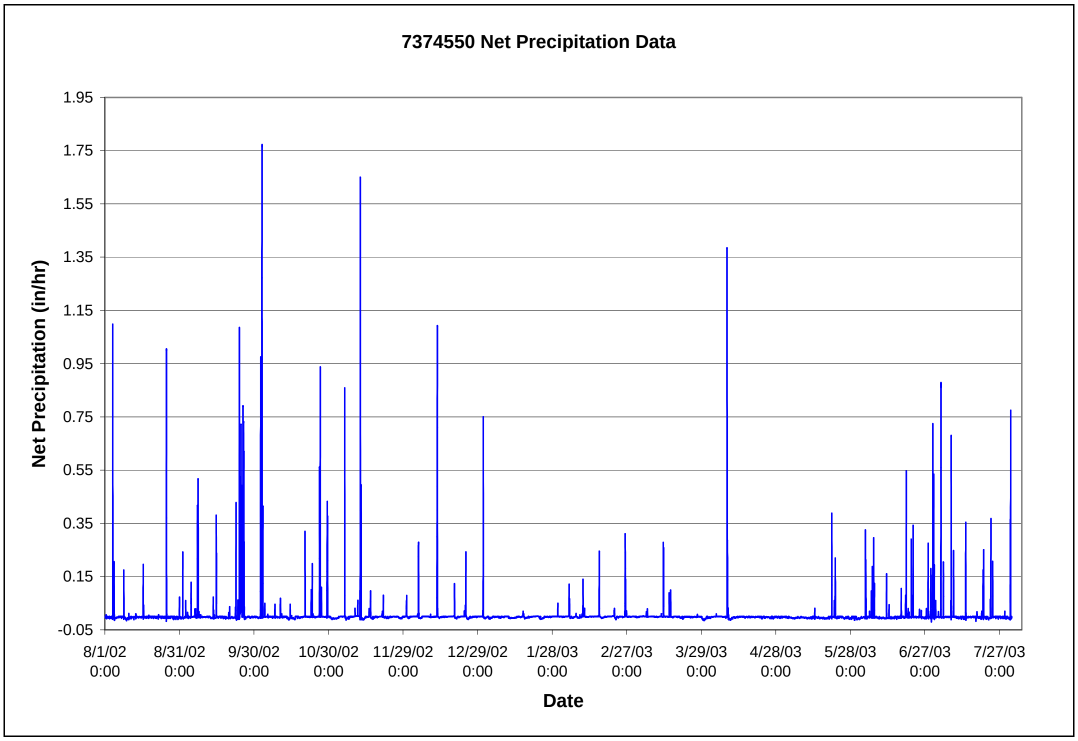


Figure 2.4-22: Net Precipitation Data at Station 7374550

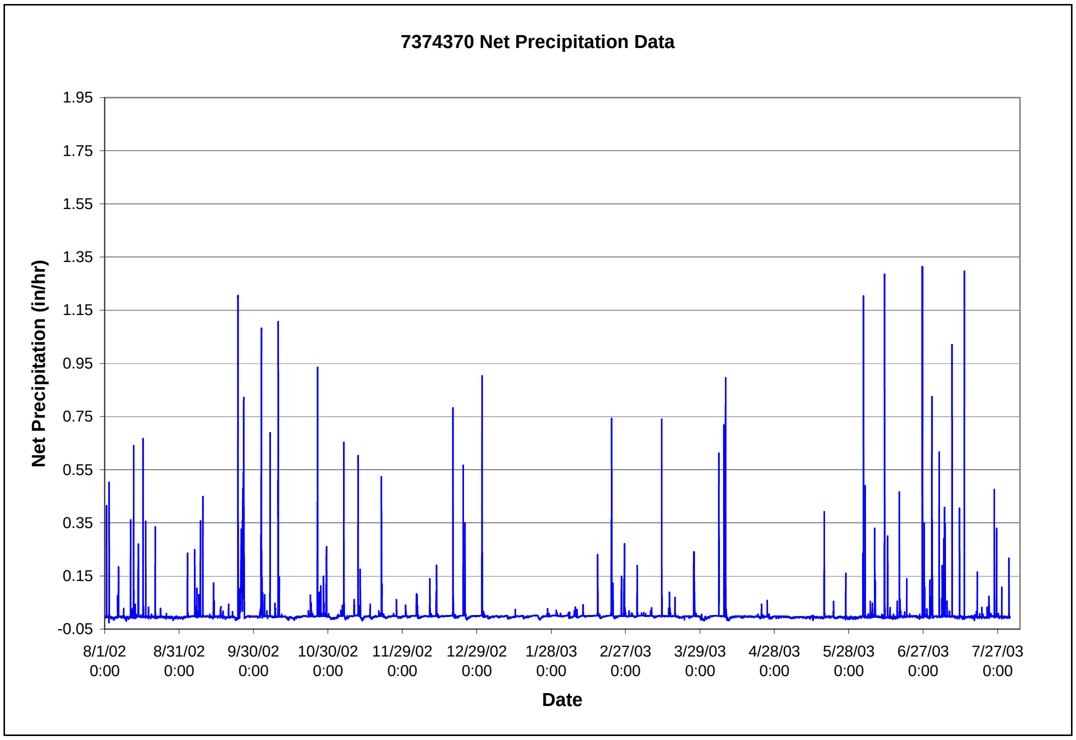


Figure 2.4-23: Net Precipitation Data at Station 7374370

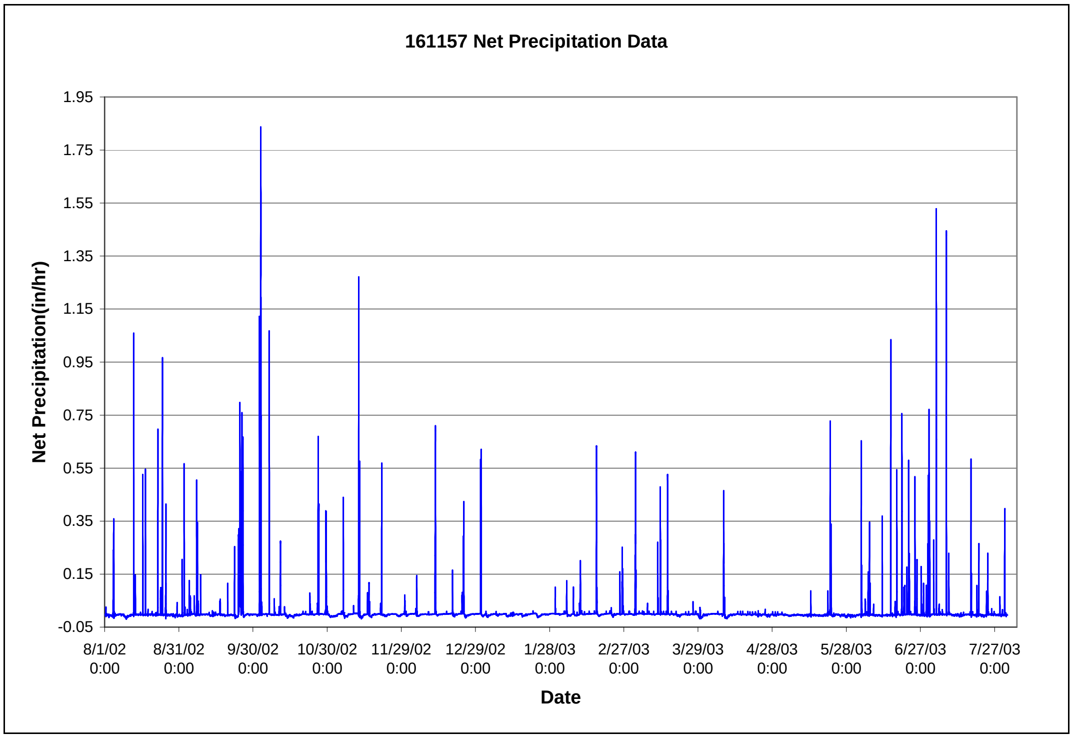


Figure 2.4-24: Net Precipitation Data at Station 161157

2.4.3 Salinity Boundary Conditions

The salinity boundary data are based on the same stations as in the previous study (Moffatt & Nichol, 2005) where continuous salinity measurements are available. These stations are Grand Isle, where the data are applied to the offshore boundary and 7381235, applied to the GIWW boundary, after 4-hour moving averaging. The salinity at all the catchment inflows is specified as zero while those at the two diversions (David Pond and Myrtle Grove) are assigned a nominal value of 0.2 ppt. Data gaps at Grand Isle were filled using the measured data at adjacent stations (Stations DCPBA08/73802512/7380251). Where the adjusted salinity is suspect (either overly elevated or depressed or devoid of any daily variation compared to those at the adjacent stations), the raw data set has been used instead. Plots of the salinity boundary condition data are shown in Figure 2.4-25 and Figure 2.4-26 for GIWW and offshore, respectively. Figure 2.4-27 presents the monthly average value for the offshore salinity input.

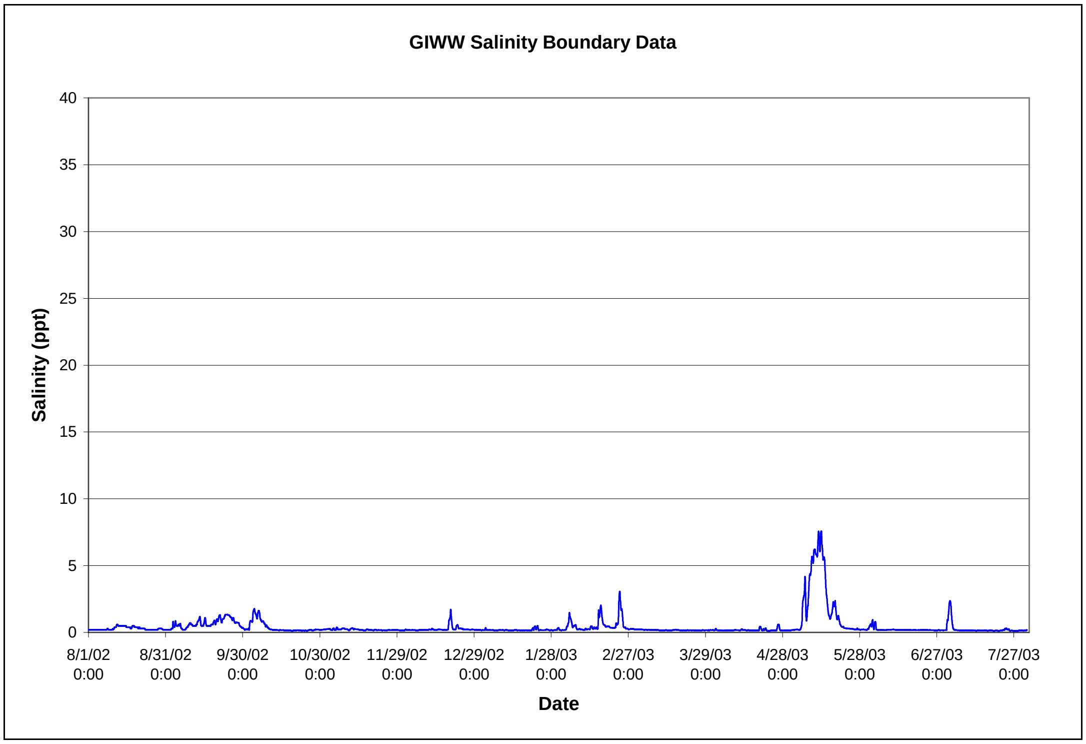


Figure 2.4-25: GIWW Salinity Boundary Data

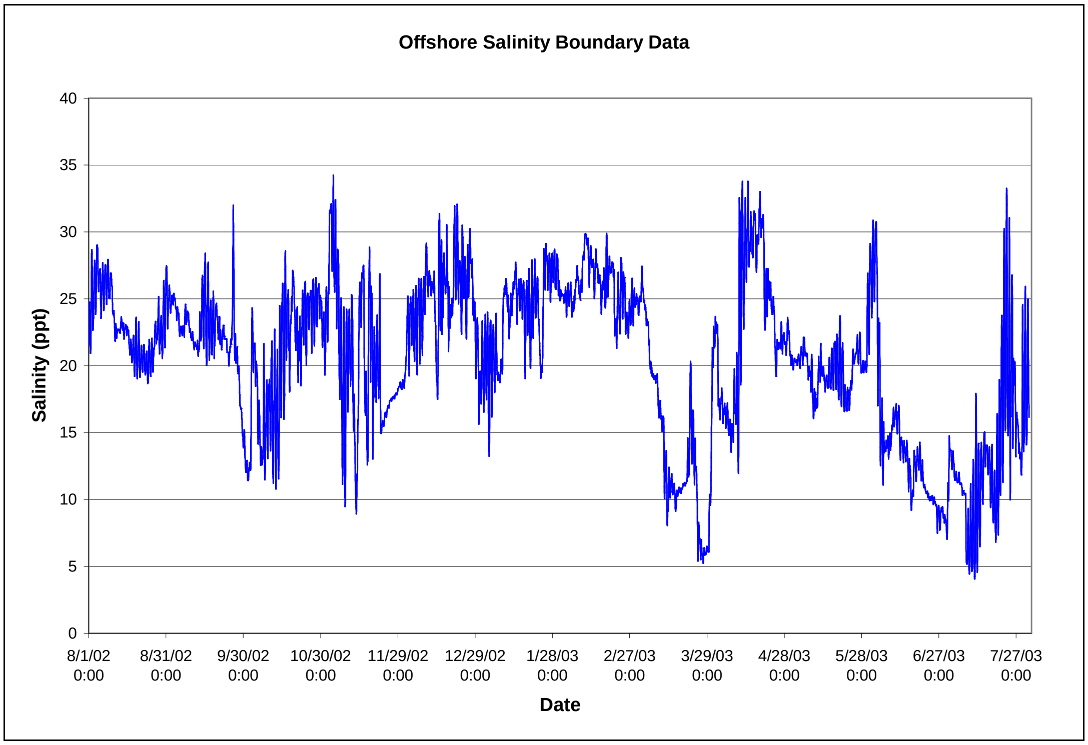


Figure 2.4-26: Offshore Salinity Boundary Data

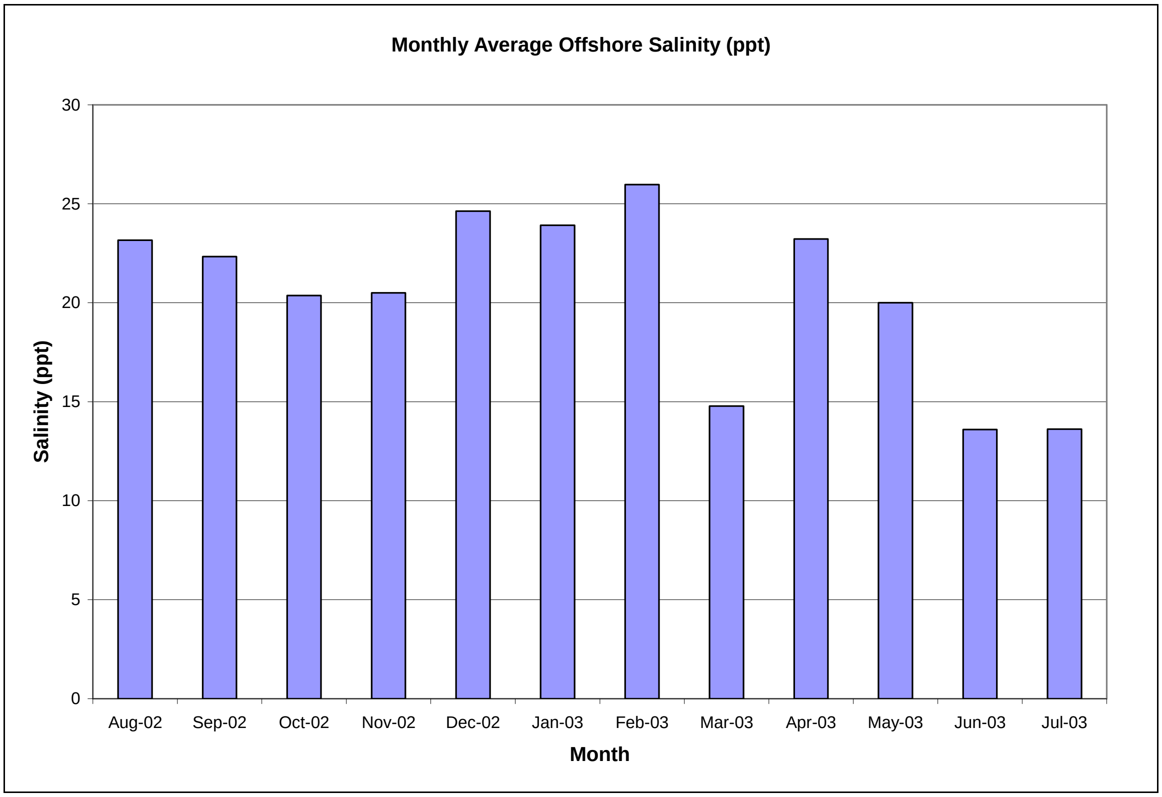


Figure 2.4-27: Monthly Average Offshore Salinity Boundary Data

3. HYDRODYNAMIC AND SALINITY MODEL CALIBRATION

3.1 HYDRODYNAMIC MODEL CALIBRATION

An extensive calibration process was performed for the original model (Moffatt & Nichol, 2005) and thus, calibration efforts are not originally included in the scope of this project. However, some modifications were made to the model grid and boundary conditions for this effort. Therefore, two calibration runs for September 2002 and December 2002 periods were performed using the revised Barataria Basin hydrodynamic model. Compared to the previous calibration/validation runs, it was confirmed that no significant changes have been introduced to the model.

3.2 SALINITY MODEL CALIBRATION

The new RMA-4 salinity model code has the ability to account for rainfall for a grid size of the Barataria Basin. Additionally the diffusion coefficients for the model were changed to automatic assignment by Peclet number instead of direct specification used by the original model. Therefore, model runs were performed with the new code and comparisons were made between the new model code runs with rainfall and the original model runs without rainfall. Minor improvements on the salinity calibration were observed.

4. BARATARIA BASIN ONE YEAR RUNS

4.1 GENERAL DESCRIPTION

An "existing" condition (no diversions) one year run was conducted first to establish the baseline for salinity change comparison. This existing condition (EXCO) run included all the boundary inputs except at the Davis Pond and Myrtle Grove Diversions where a nominal flow is applied as the hydrodynamic boundary. Input discharge conditions at Davis Pond and Myrtle Grove for the twelve alternative model runs are reproduced here for convenient reference (Figure 4.1-1). Additionally, three extra runs were made to distinguish the effects of the Davis Pond Diversion from those due to the Myrtle Grove Diversion. For these three runs, nominal discharge boundary conditions at the Myrtle Grove Diversion were applied coupled with the three different Davis Pond Diversion discharge scenarios.

After the one year runs were completed, the salinity time series results were averaged on a monthly, semi-annual (December – May), and an annual basis. Salinity comparisons are presented in this section for the annually averaged results. Monthly and semi-annually results are included in the corresponding Appendices. Figure 4.1-2 shows the annually averaged salinity results for the existing condition run. Monthly and semi-annually averaged results are included in Appendix B for the existing condition runs.

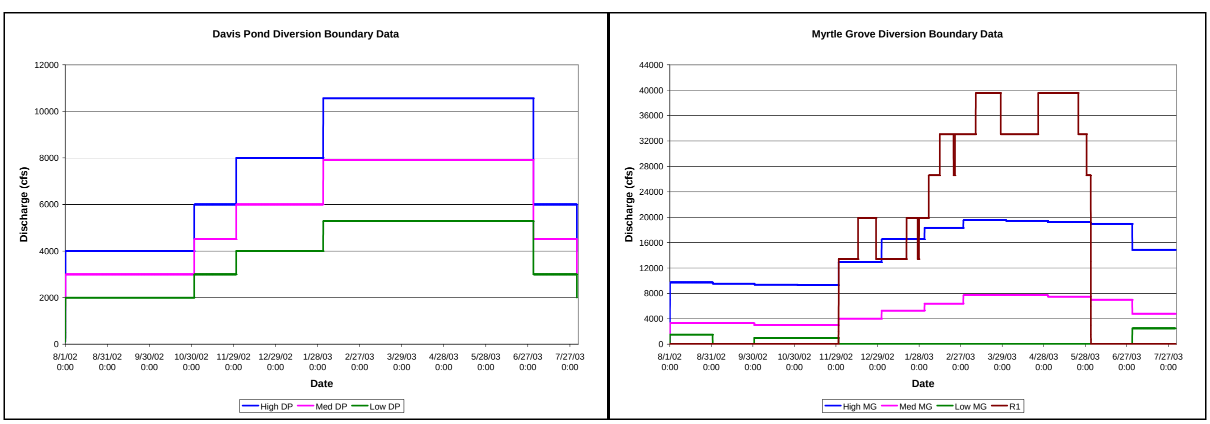


Figure 4.1-1: Davis Pond and Myrtle Grove Discharge Boundary Conditions

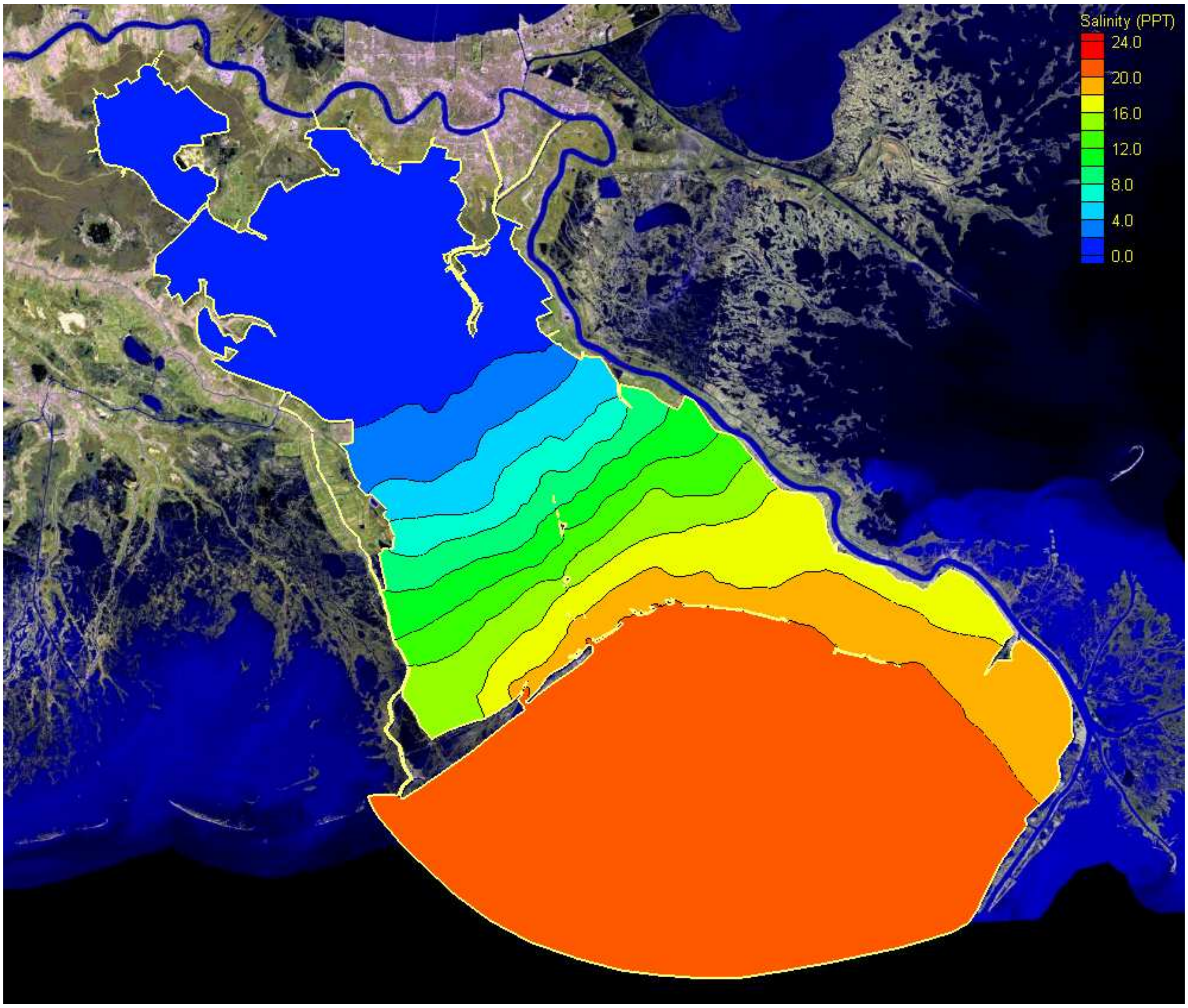


Figure 4.1-2: EXCO Salinity Annually Average

4.2 HIGH DAVIS POND AND HIGH MYRTLE GROVE (DHMH)

In this one year model run, high fresh water discharges at both the Davis Pond Diversion and the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.2-1 and Figure 4.2-2, respectively. Negative salinity change values represent reduction in salinity due to discharges from the diversions.

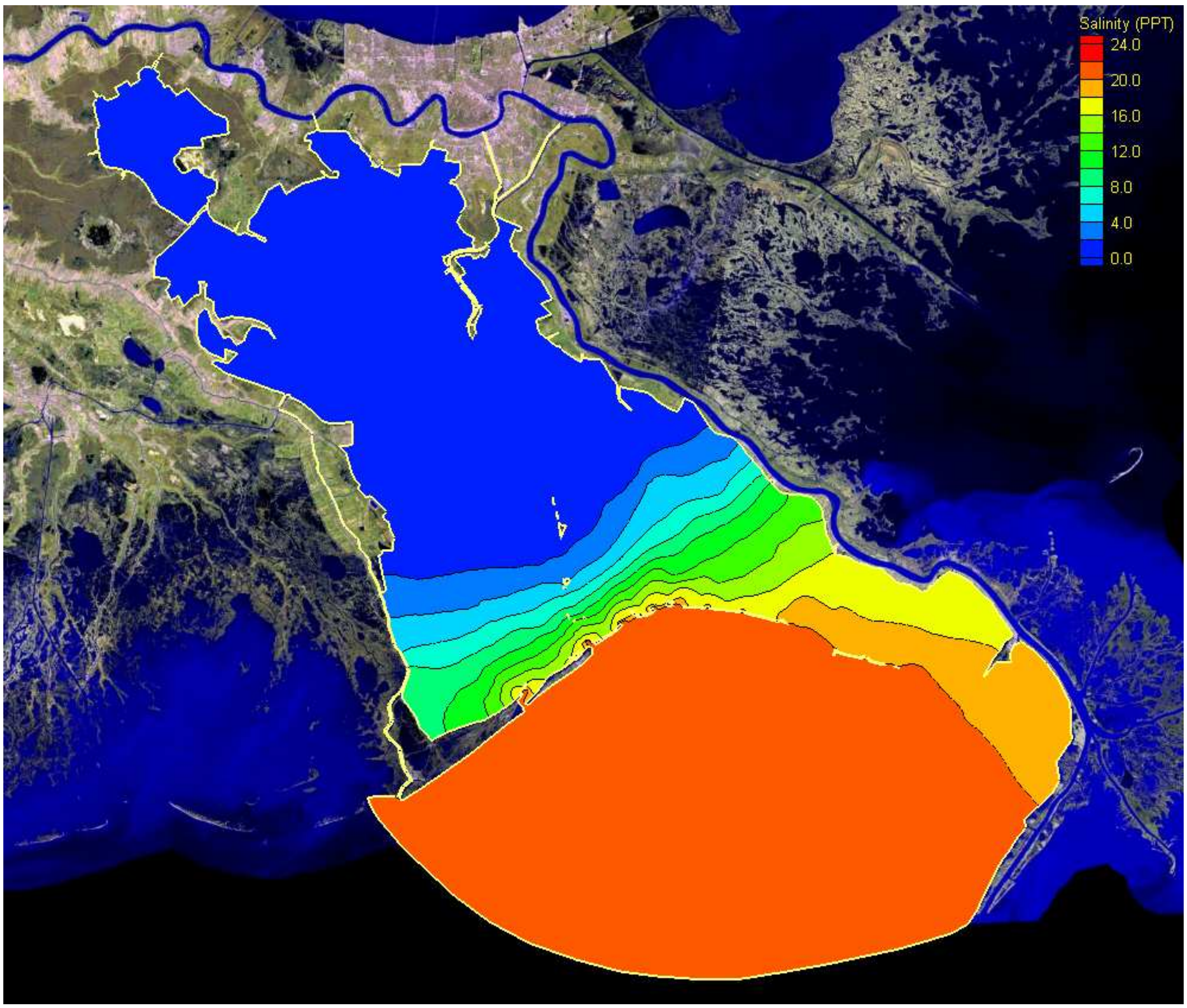


Figure 4.2-1: DHMH Salinity Annually Average

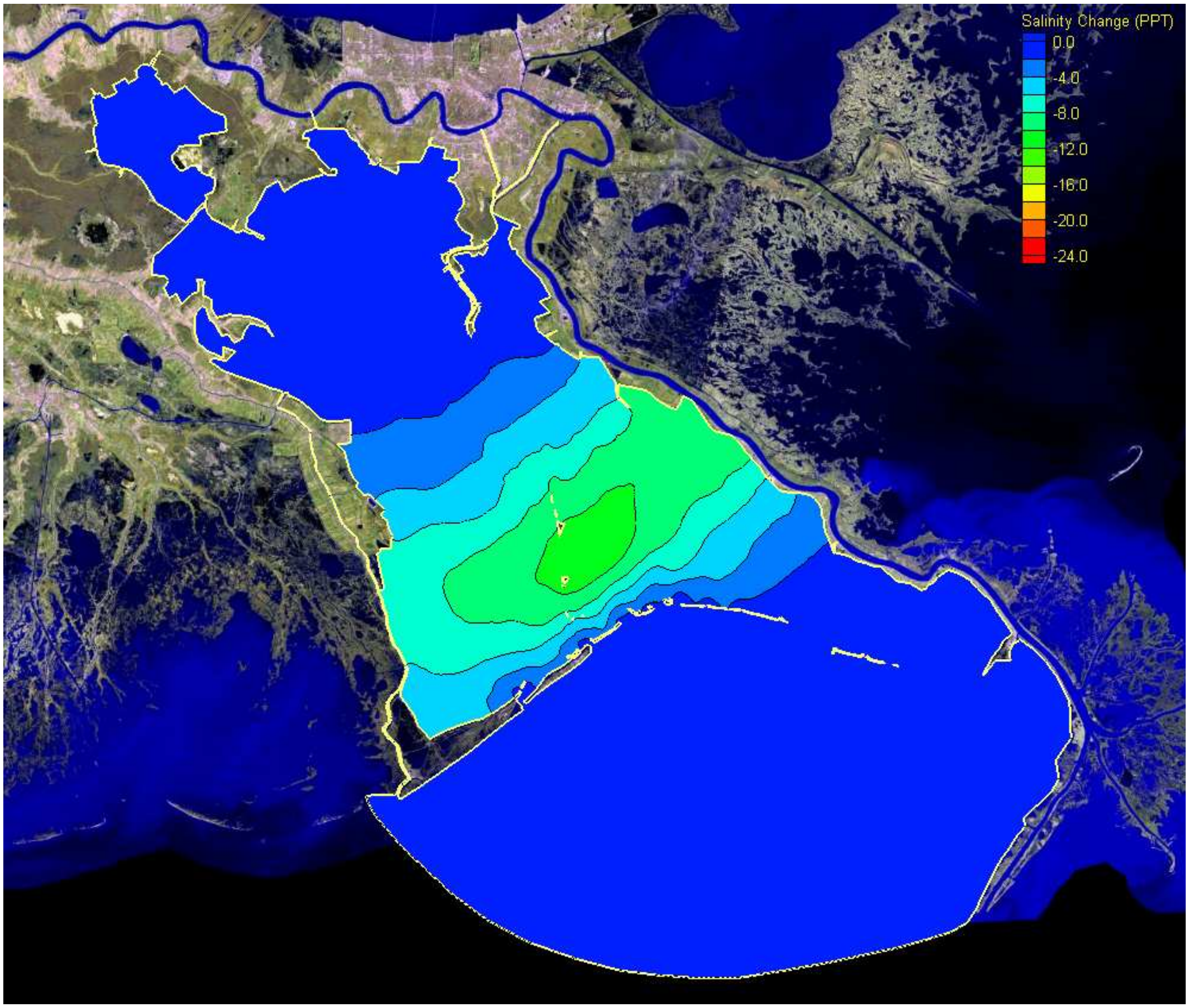


Figure 4.2-2: DHMH Annually Averaged Salinity Change Relative to EXCO

Under this high discharges scenario for both Davis Pond and Myrtle Grove, the annually averaged salinity was lowered by more than 10 ppt in the Barataria Bay. It could reduce the salinity by more than 20 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix C.

4.3 HIGH DAVIS POND AND MEDIUM MYRTLE GROVE (DHMM)

For this one year model run, high discharges at the Davis Pond Diversion and medium discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.3-1 and Figure 4.3-2, respectively.

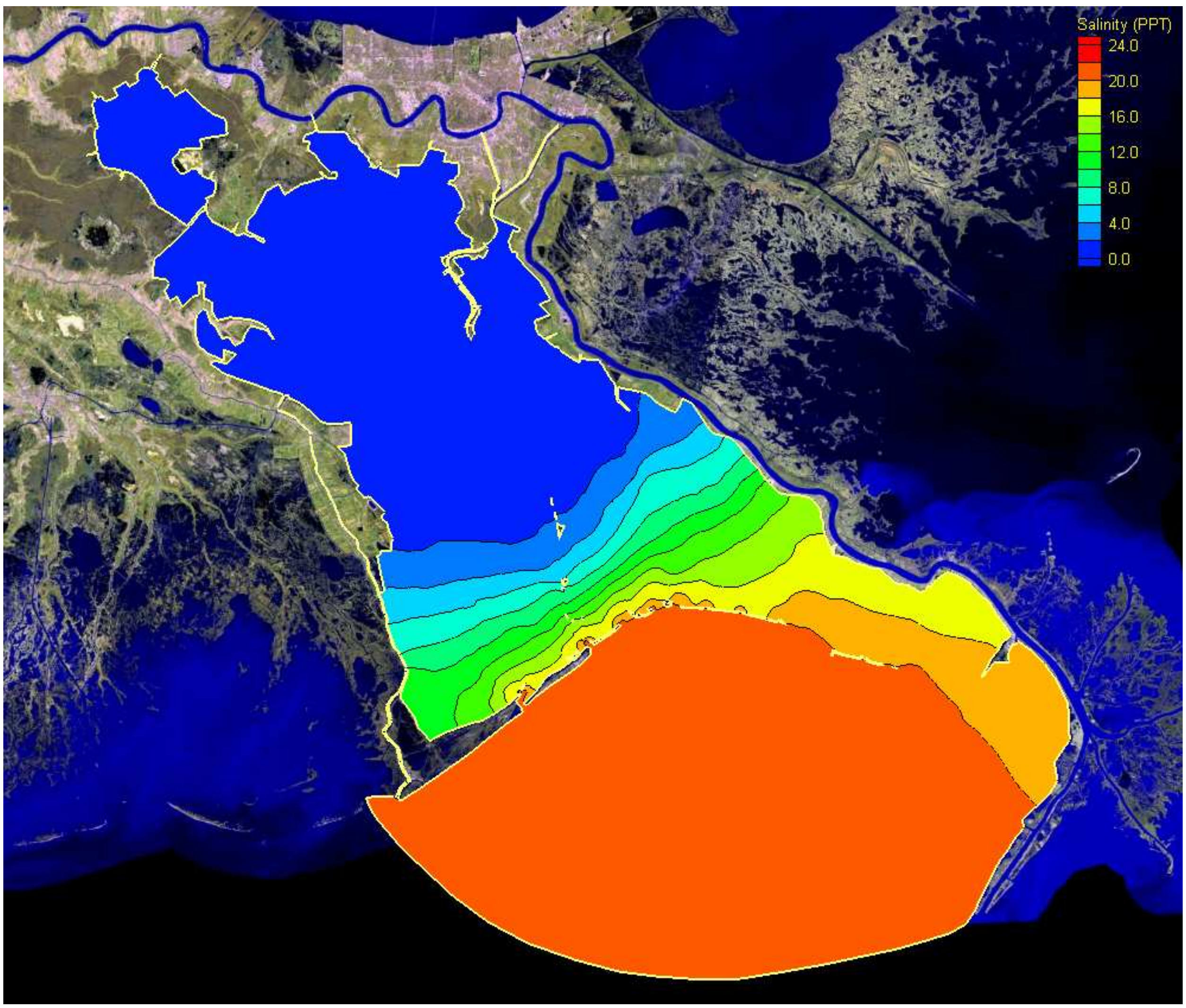


Figure 4.3-1: DHMM Salinity Annually Average

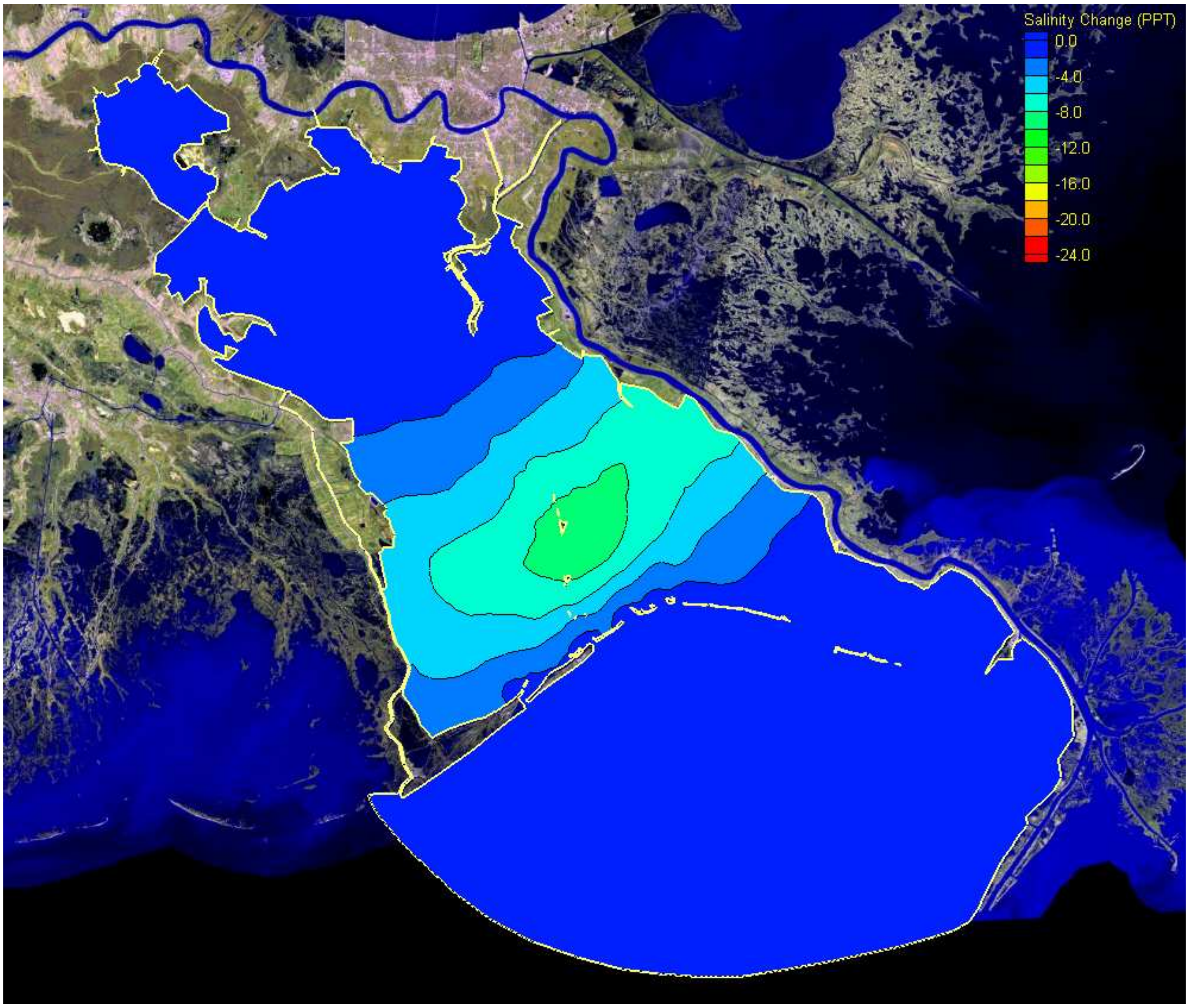


Figure 4.3-2: DHMM Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 8 ppt in the Barataria Bay. It could reduce the salinity by more than 18 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix D.

4.4 HIGH DAVIS POND AND LOW MYRTLE GROVE (DHML)

For this one year model run, high discharges at the Davis Pond Diversion and low discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.4-1and Figure 4.4-2, respectively.

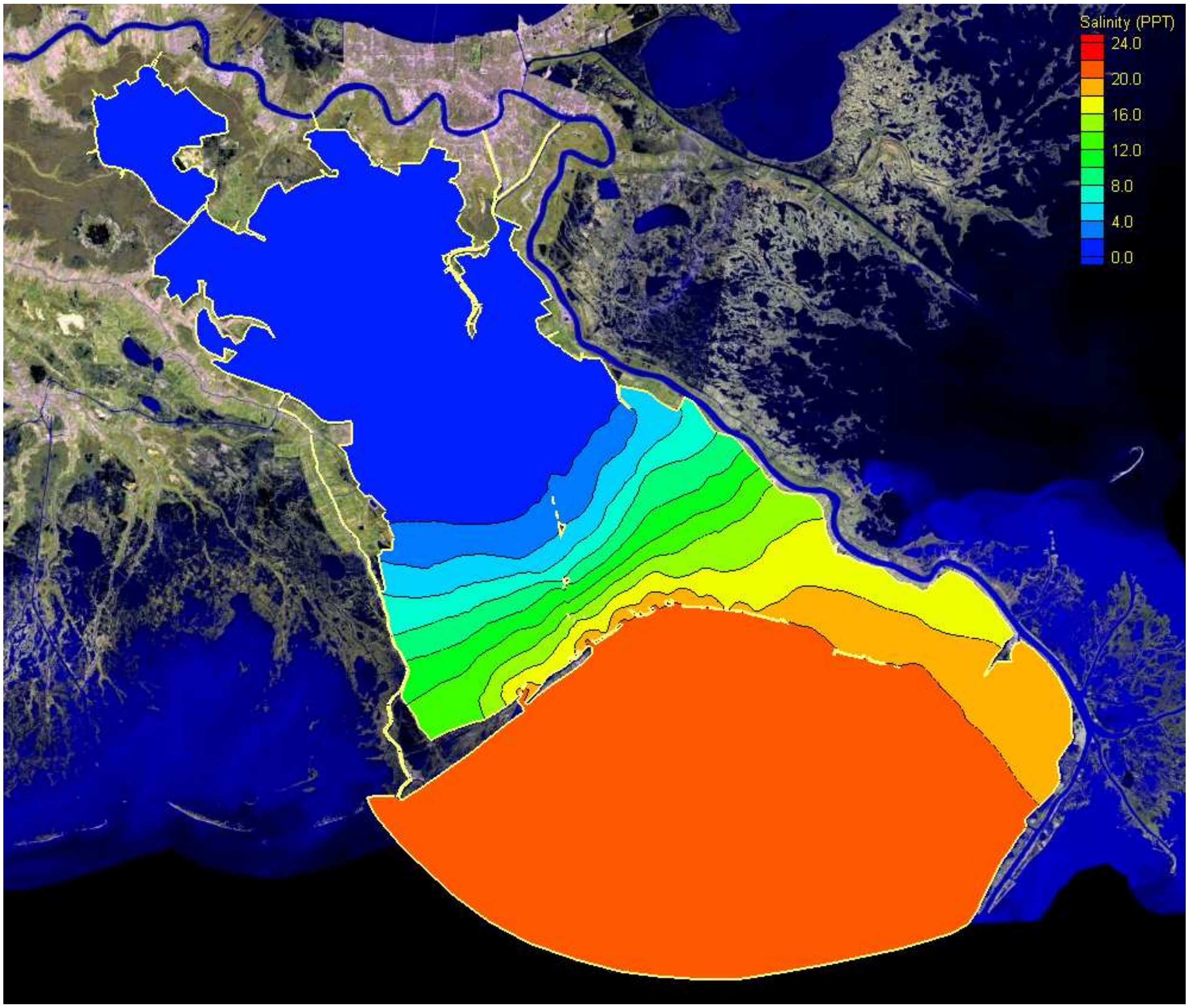


Figure 4.4-1: DHML Salinity Annually Average

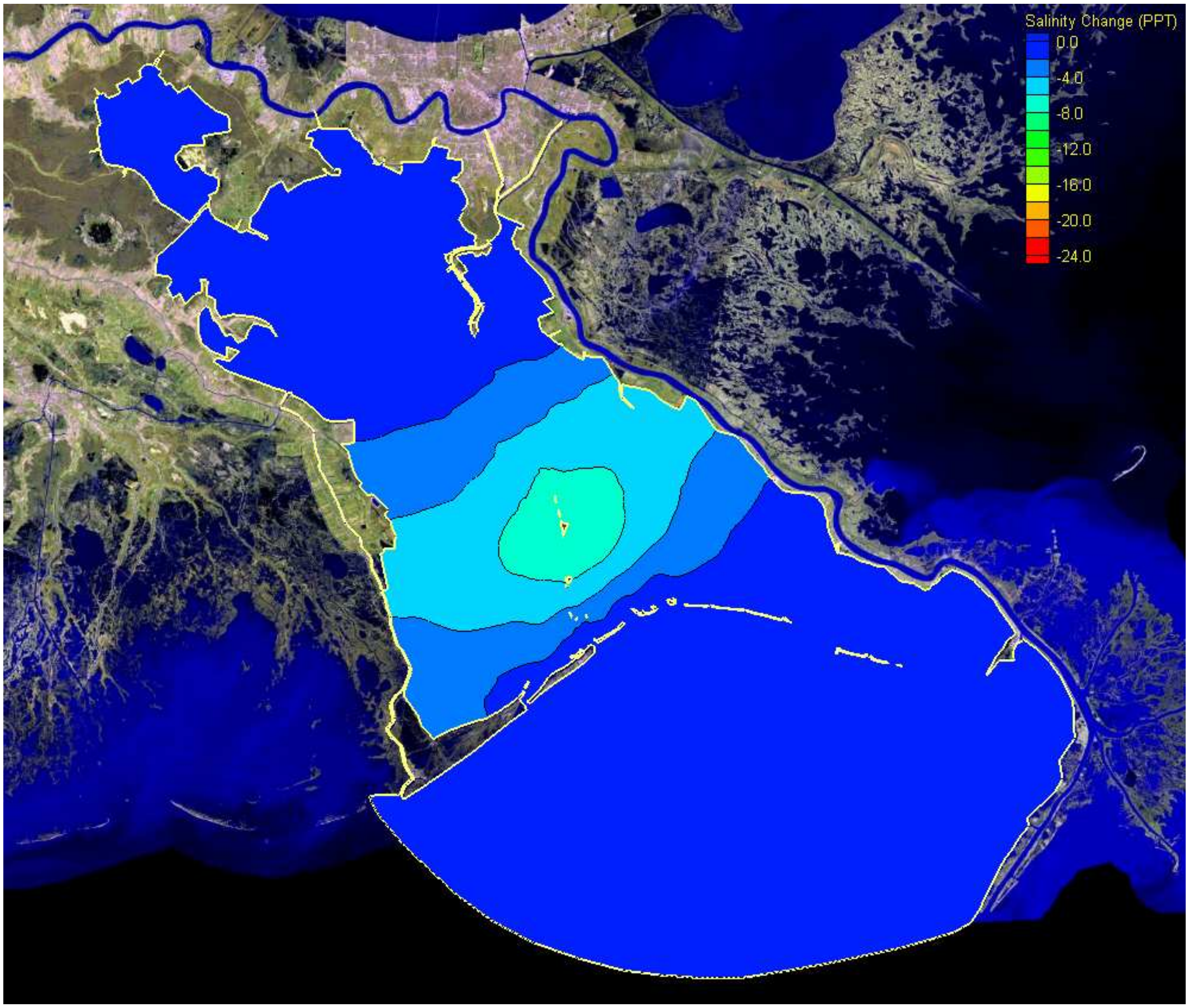


Figure 4.4-2: DHML Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 6 ppt in the Barataria Bay. It could reduce the salinity by more than 14 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix E.

4.5 MEDIUM DAVIS POND AND HIGH MYRTLE GROVE (DMMH)

For this one year model run, medium discharges at the Davis Pond Diversion and high discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.5-1 and Figure 4.5-2, respectively.

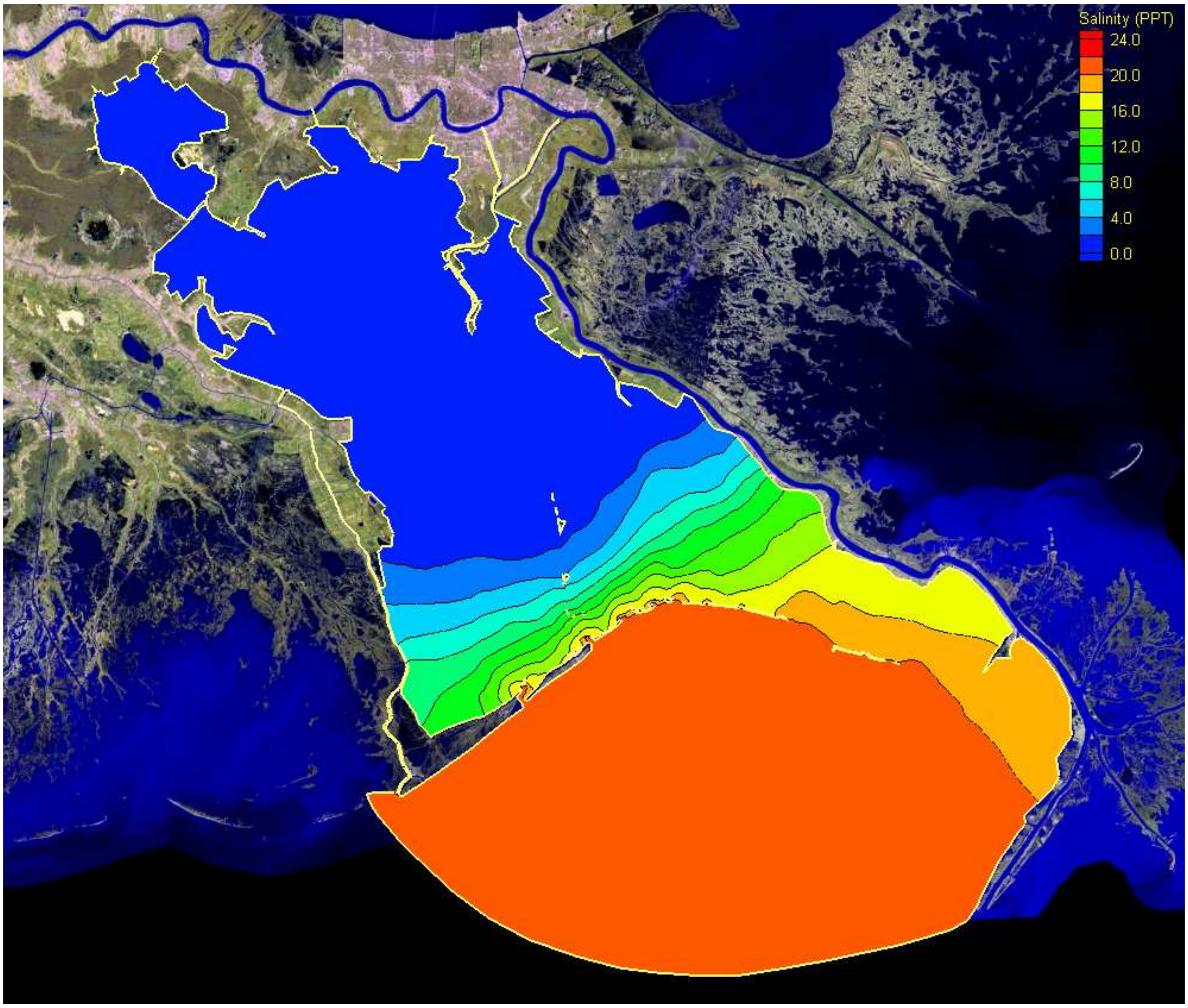


Figure 4.5-1: DMMH Salinity Annually Average

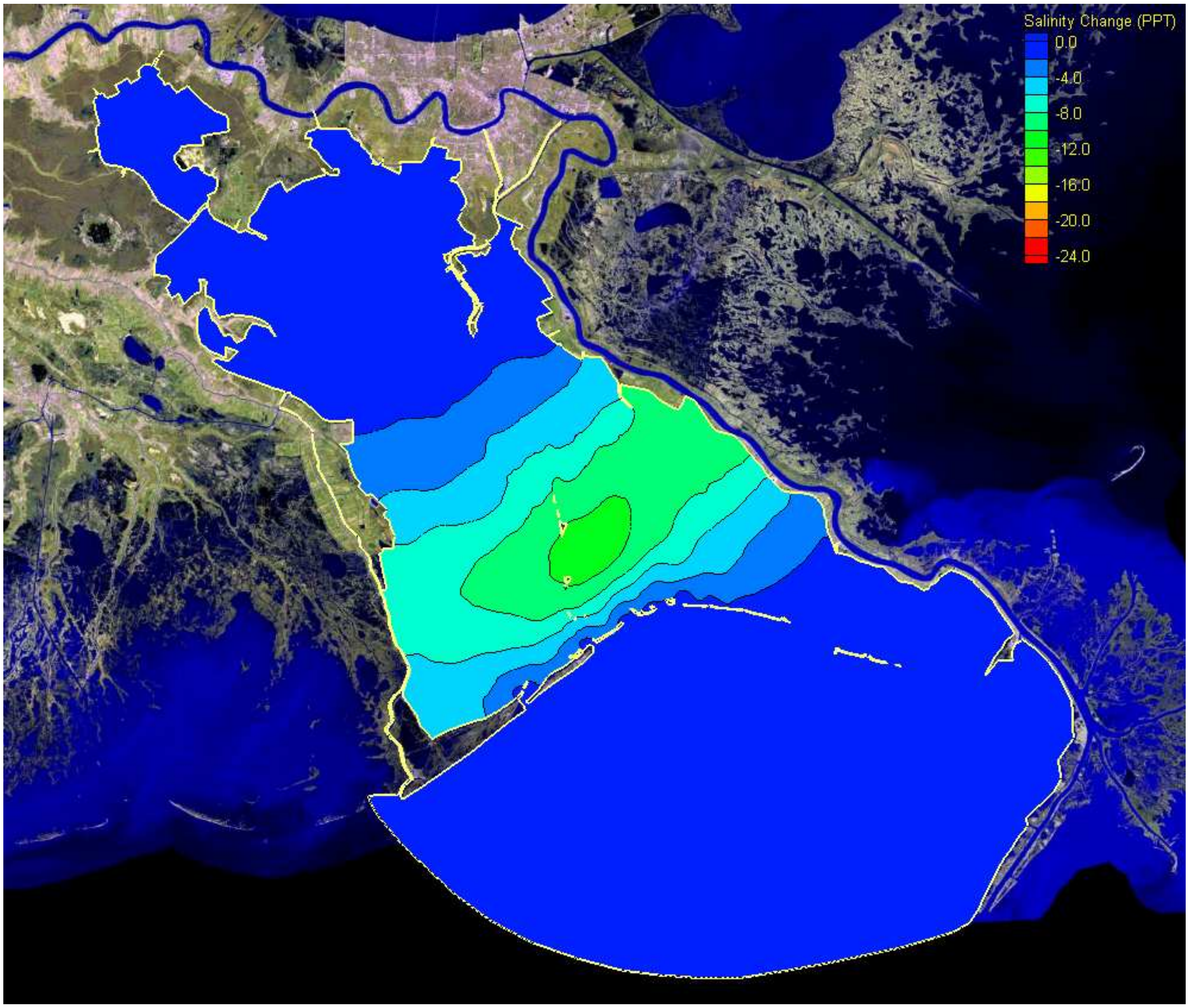


Figure 4.5-2: DMMH Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by as much as 10 ppt in the Barataria Bay. It could reduce the salinity by more than 18 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix F.

4.6 MEDIUM DAVIS POND AND MEDIUM MYRTLE GROVE (DMMM)

For this one year model run, medium discharges at the Davis Pond Diversion and medium discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.6-1 and Figure 4.6-2, respectively.

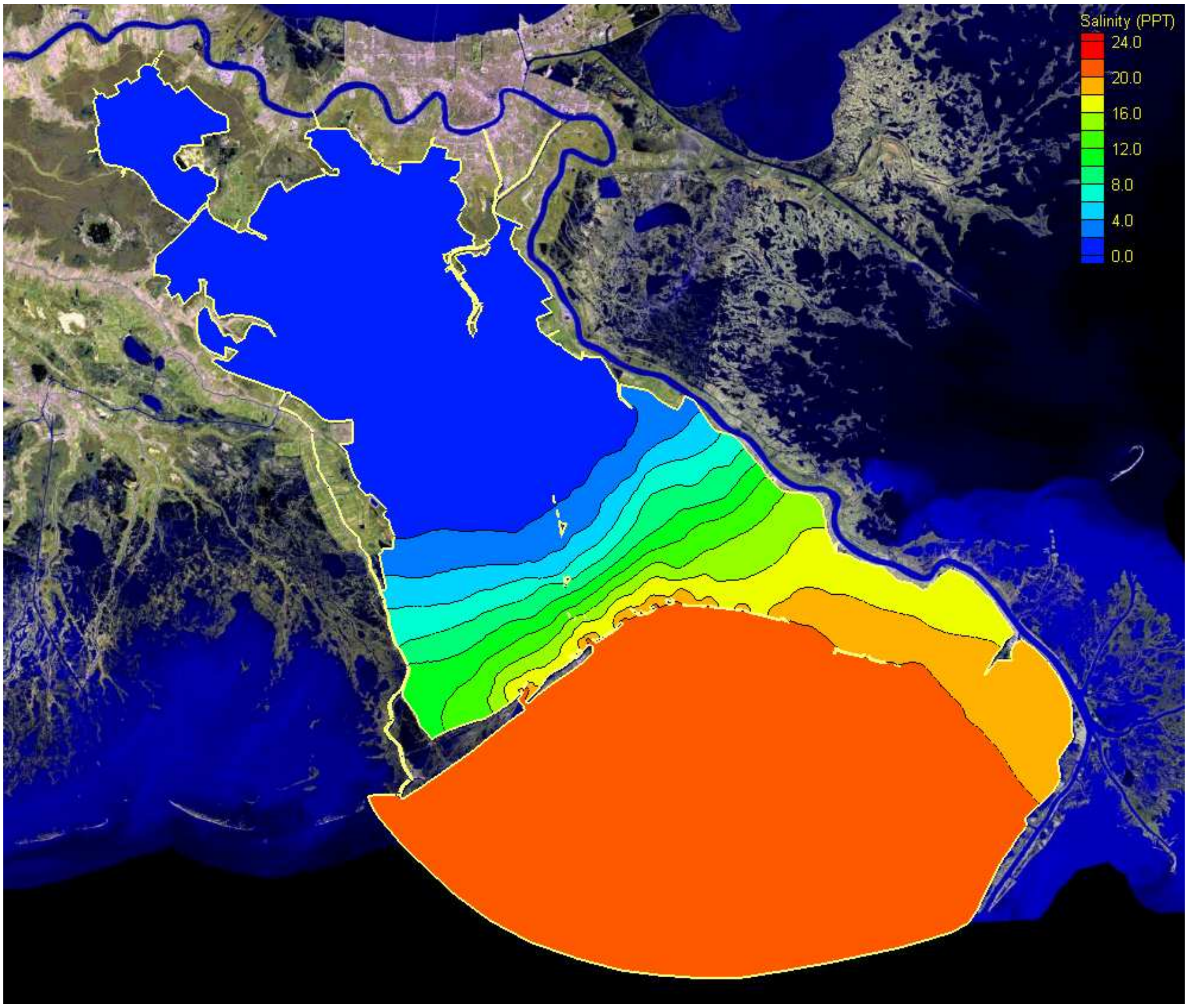


Figure 4.6-1: DMMM Salinity Annually Average

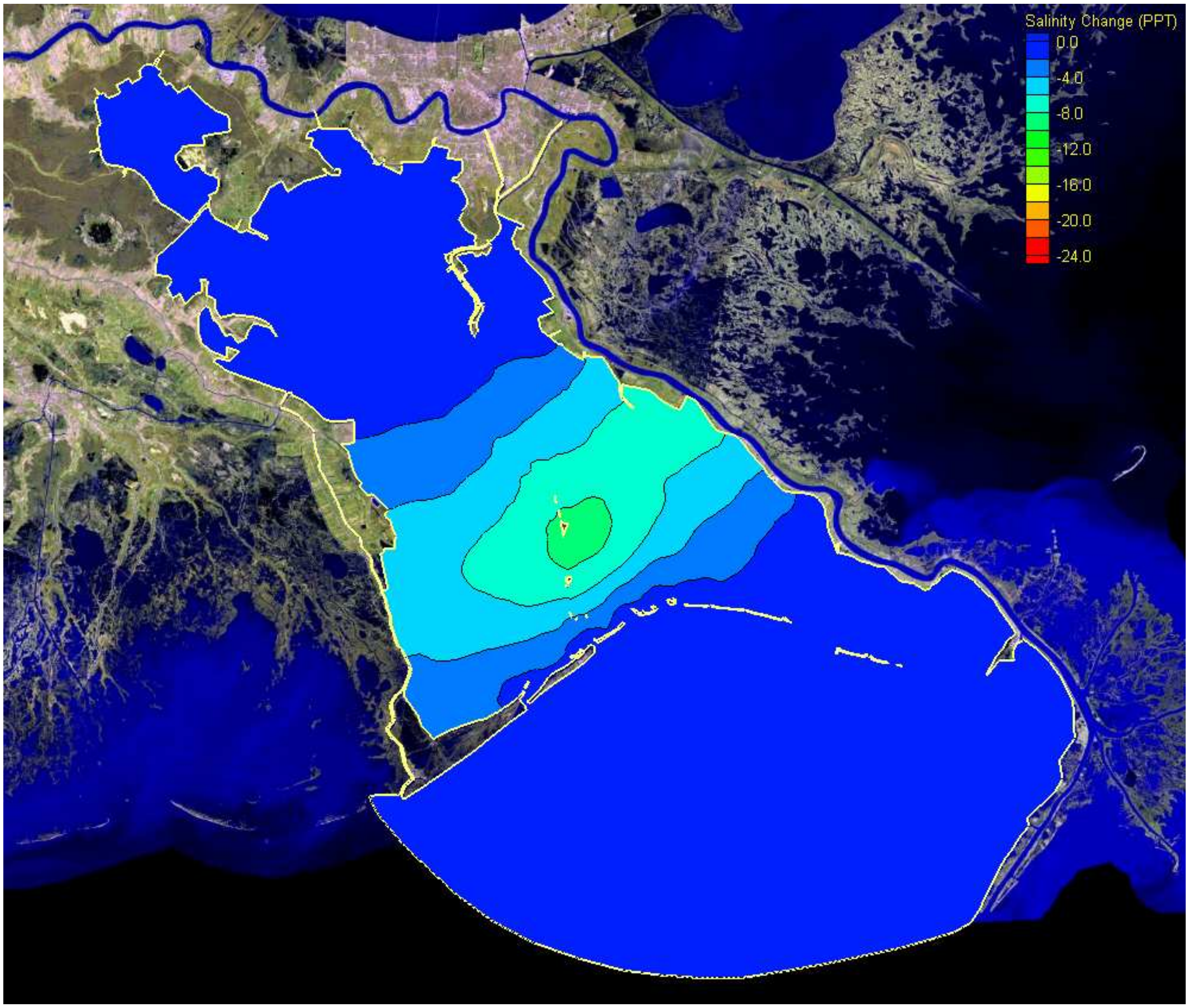


Figure 4.6-2: DMMM Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 8 ppt in the Barataria Bay. It could reduce the salinity by more than 16 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix G.

4.7 MEDIUM DAVIS POND AND LOW MYRTLE GROVE (DMML)

For this one year model run, medium discharges at the Davis Pond Diversion and low discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.7-1 and Figure 4.7-2, respectively.

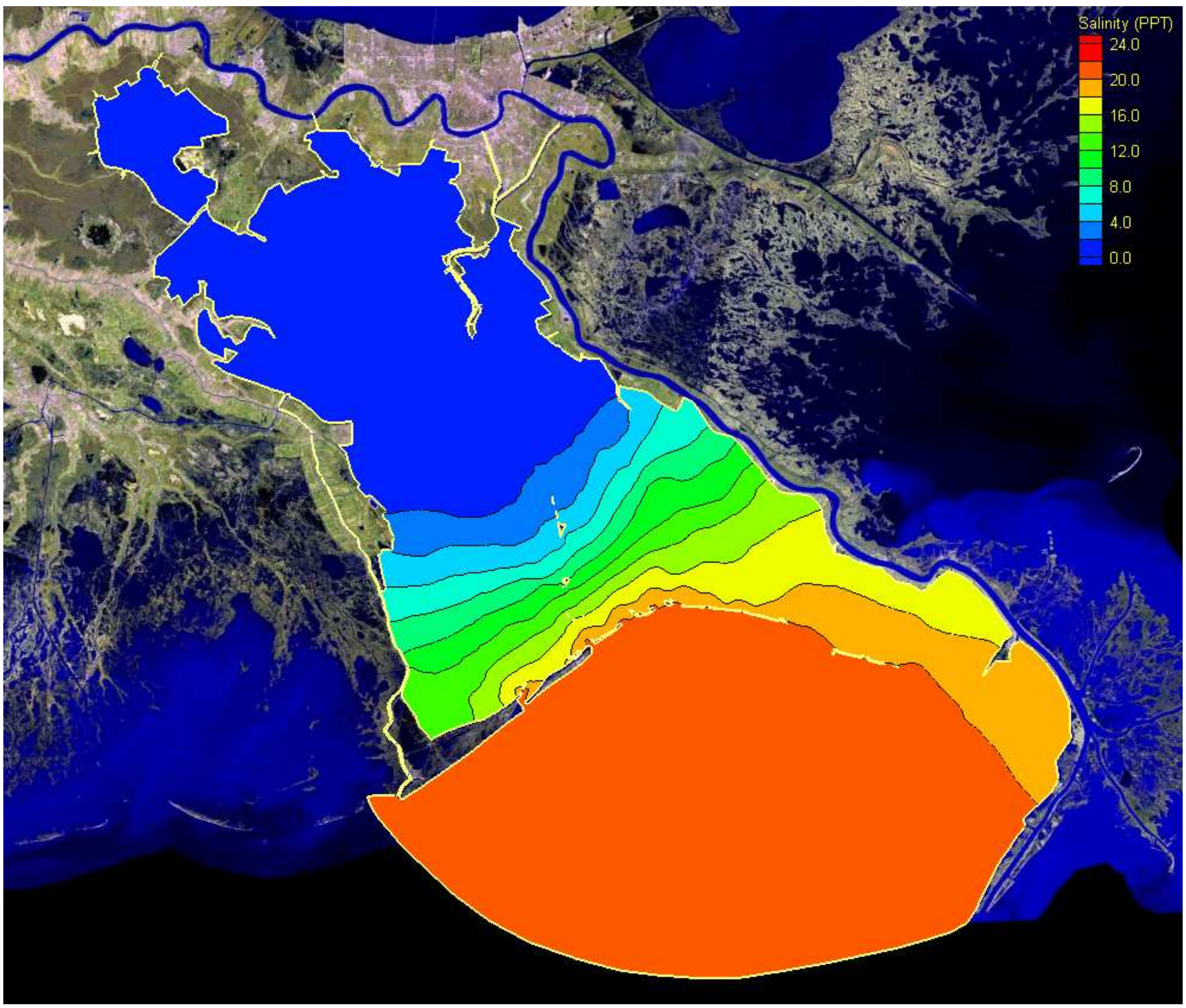


Figure 4.7-1: DMML Salinity Annually Average

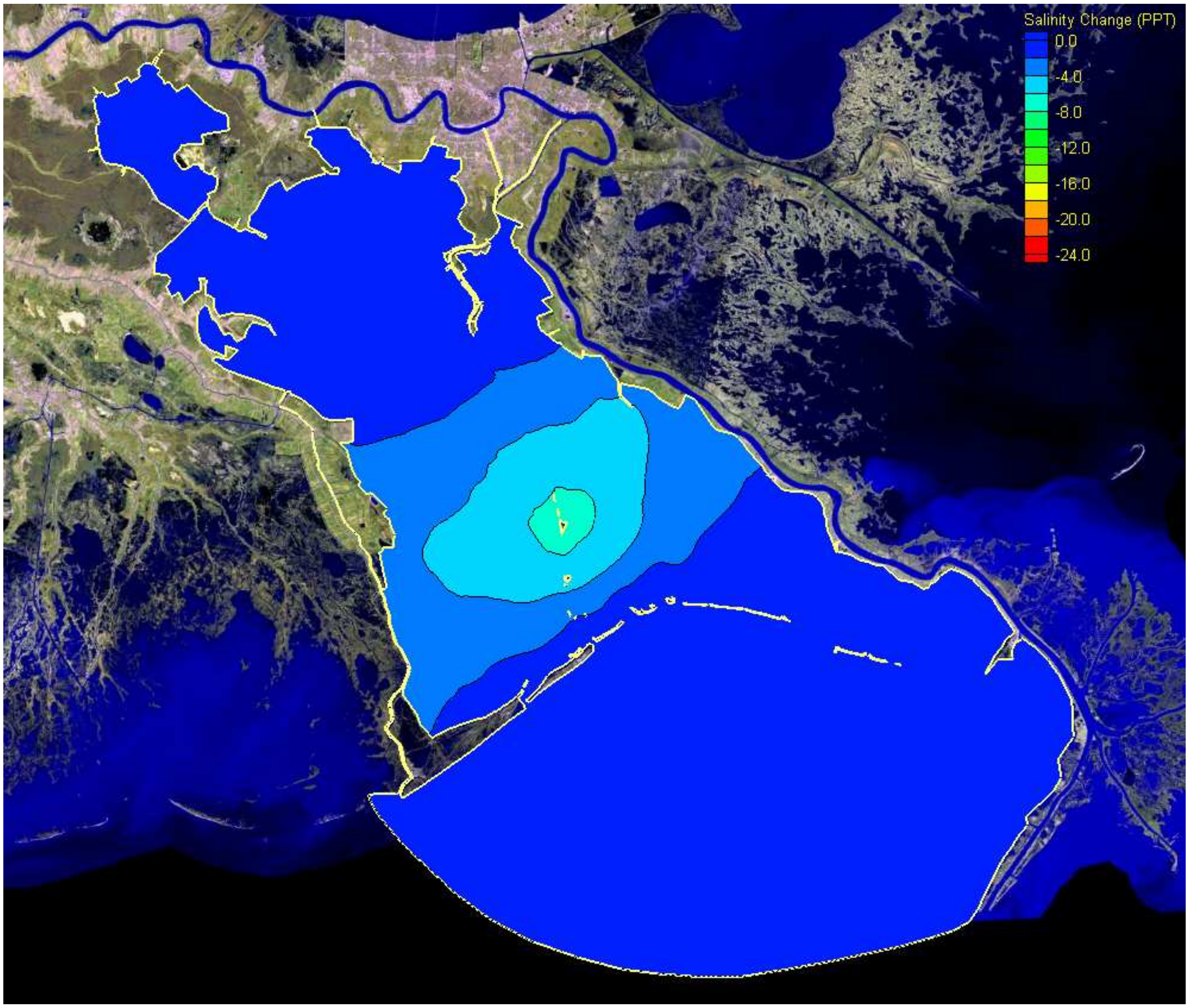


Figure 4.7-2: DMML Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 6 ppt in the Barataria Bay. It could reduce the salinity by more than 12 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix H.

4.8 LOW DAVIS POND AND HIGH MYRTLE GROVE (DLMH)

For this one year model run, low discharges at the Davis Pond Diversion and high discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.8-1 and Figure 4.8-2, respectively.

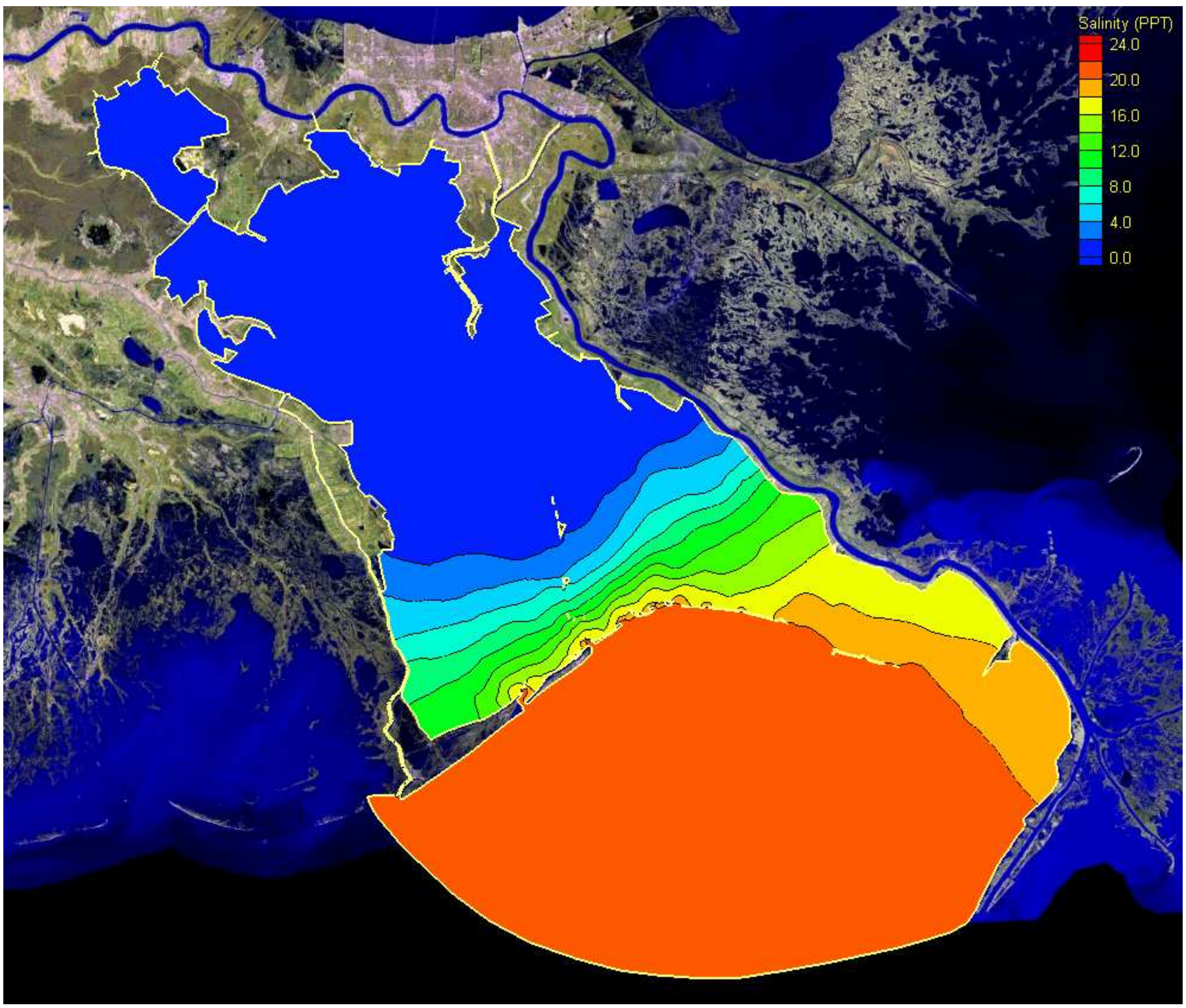


Figure 4.8-1: DLMH Salinity Annually Average

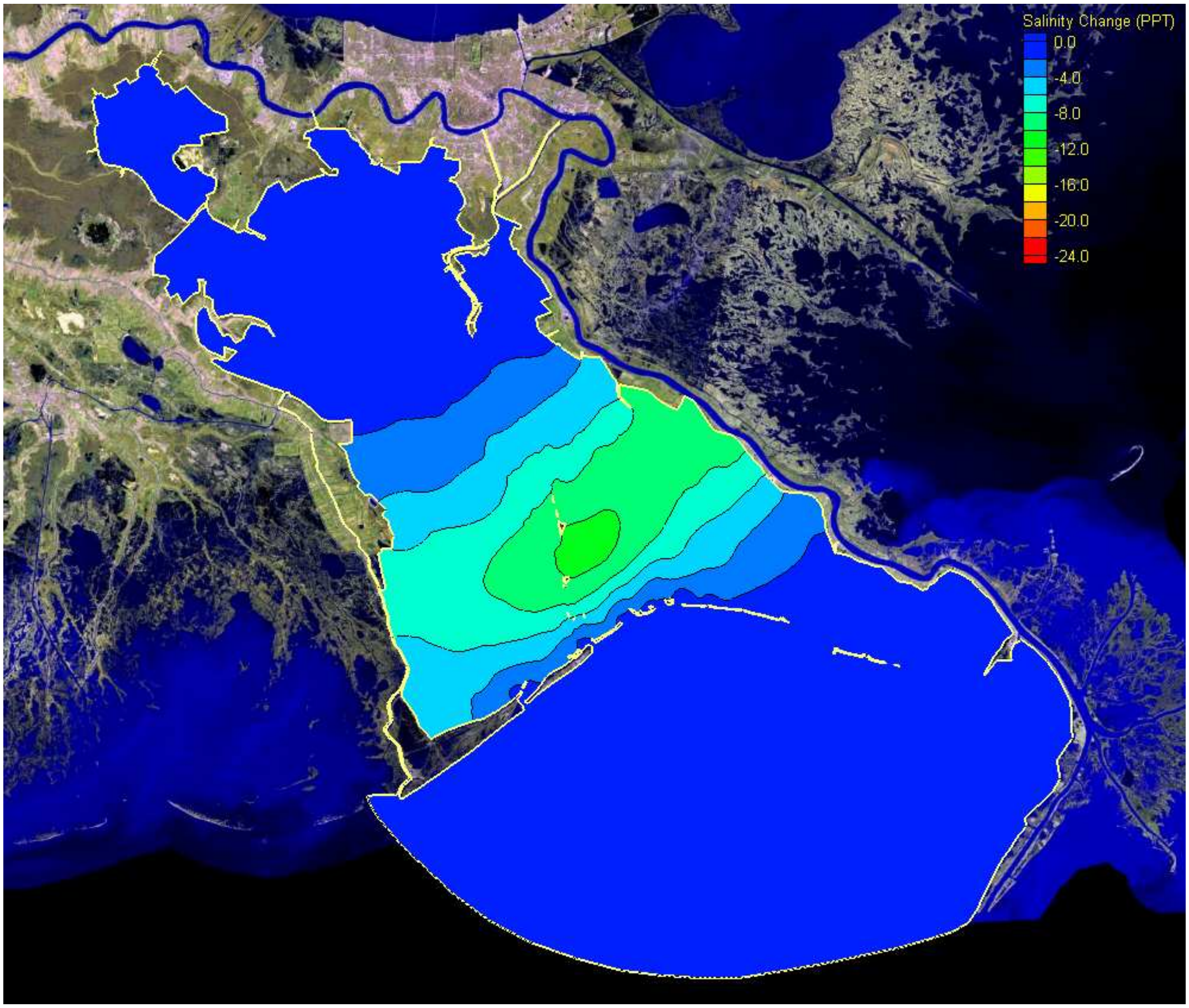


Figure 4.8-2: DLMH Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 10 ppt in the Barataria Bay. It could reduce the salinity by more than 18 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix I.

4.9 LOW DAVIS POND AND MEDIUM MYRTLE GROVE (DLMM)

For this one year model run, low discharges at the Davis Pond Diversion and medium discharges at the Myrtle Grove Diversion are applied. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.9-1 and Figure 4.9-2, respectively.

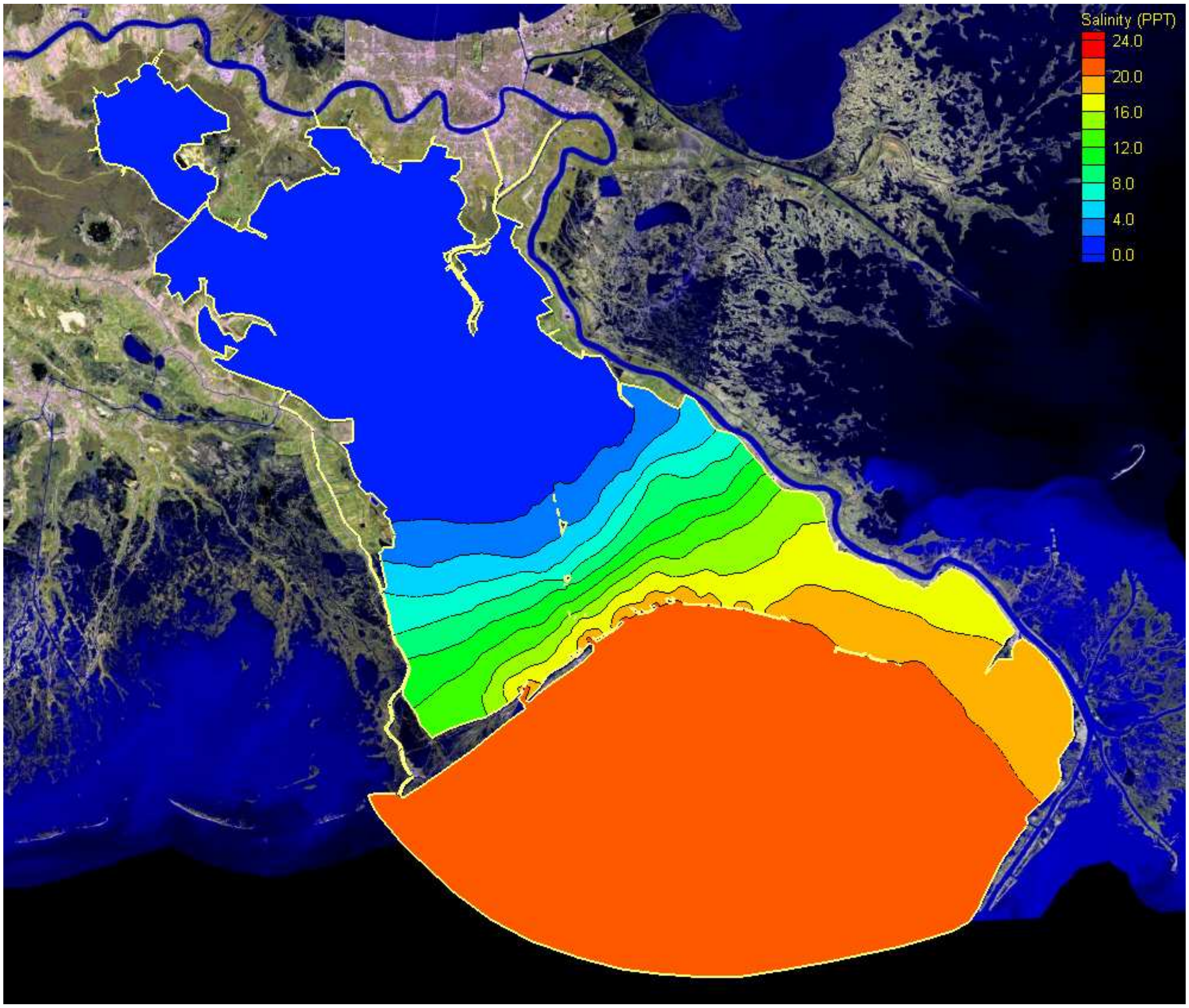


Figure 4.9-1: DLMM Salinity Annually Average

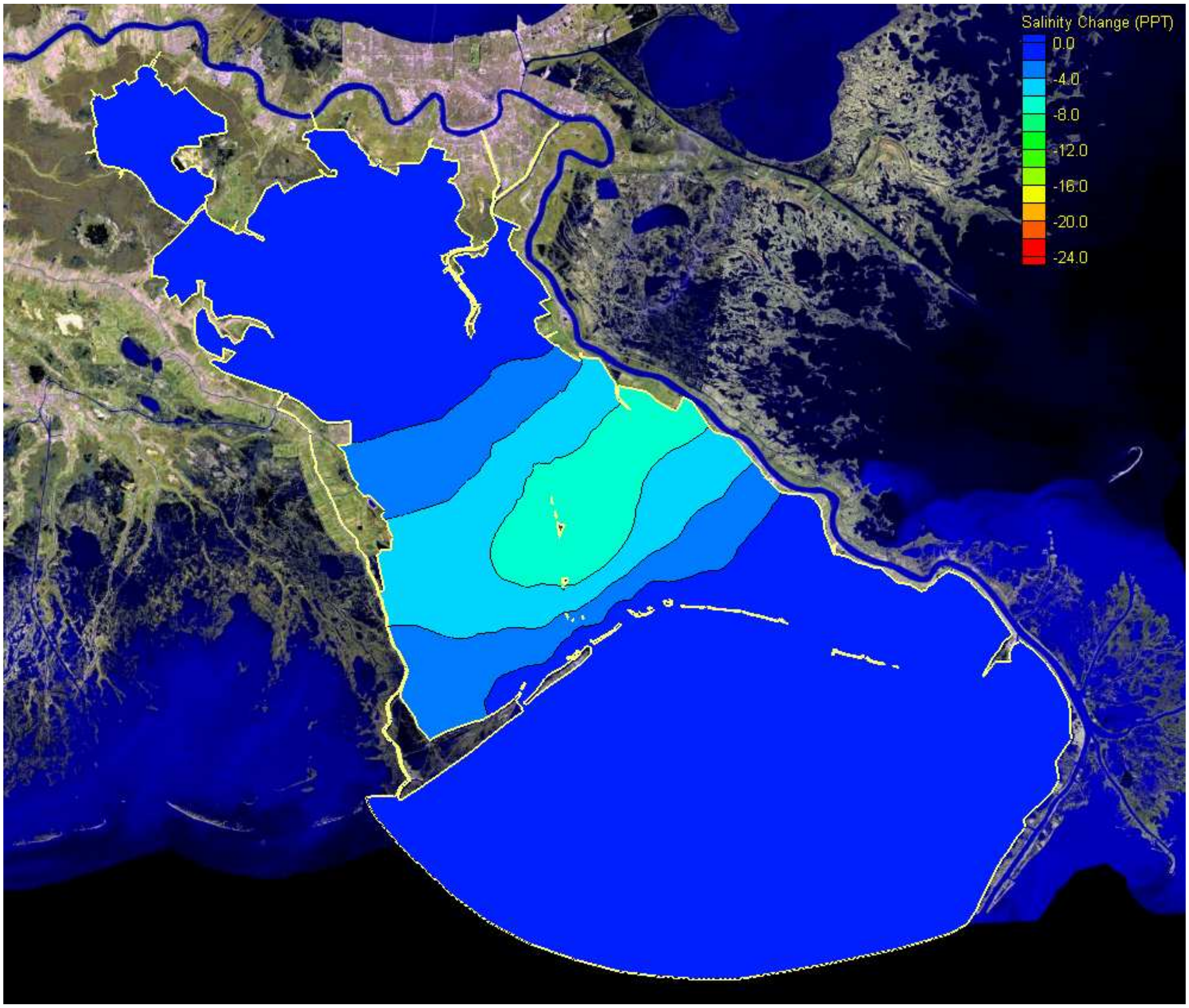


Figure 4.9-2: DLMM Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by close to 8 ppt in the Barataria Bay. It could reduce the salinity by more than 16 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix J.

4.10 LOW DAVIS POND AND LOW MYRTLE GROVE (DLML)

This model run uses low discharges at the Davis Pond Diversion and low discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.10-1 and Figure 4.10-2, respectively.

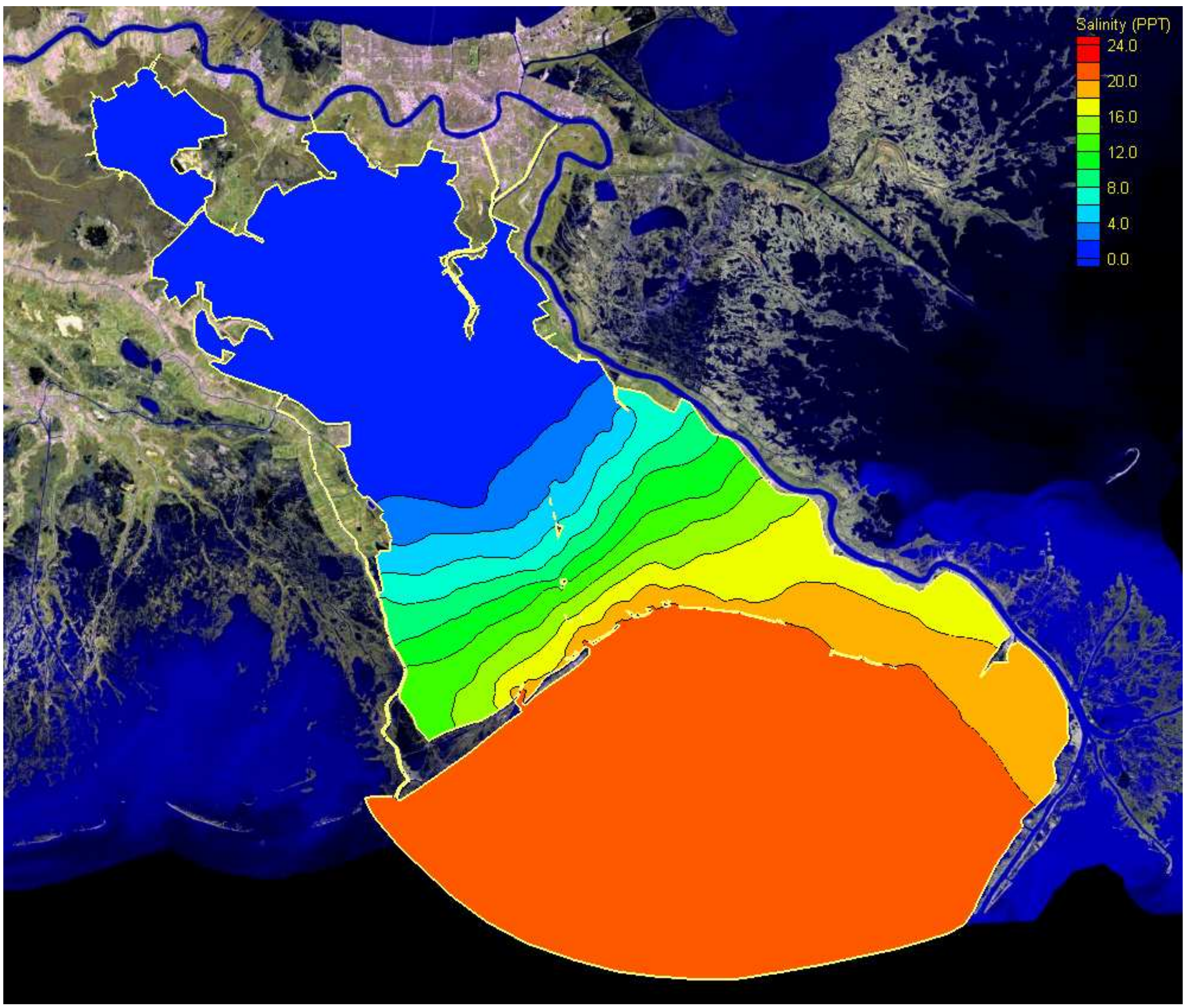


Figure 4.10-1: DLML Salinity Annually Average

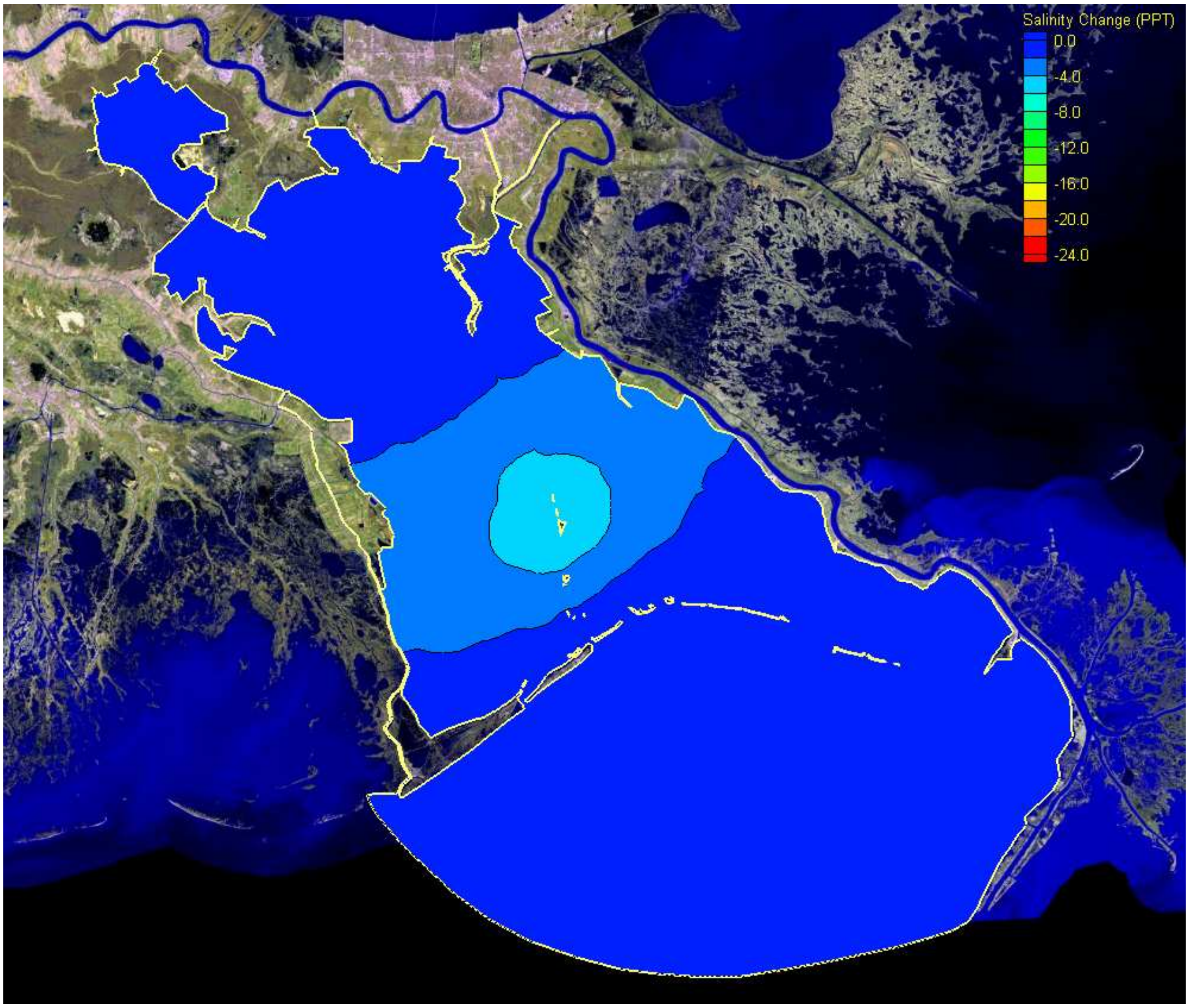


Figure 4.10-2: DLML Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by over 4 ppt in the Barataria Bay. It could reduce the salinity by more than 8 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix K.

4.11 HIGH DAVIS POND AND NOMINAL MYRTLE GROVE (DHMN)

Since the Davis Pond Diversion is now operational, additional runs for just its flow were made so the relative effects of the two diversions could be isolated from each other. The first extra one year model run uses high discharges at the Davis Pond Diversion and nominal discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.11-1 and Figure 4.11-2, respectively.

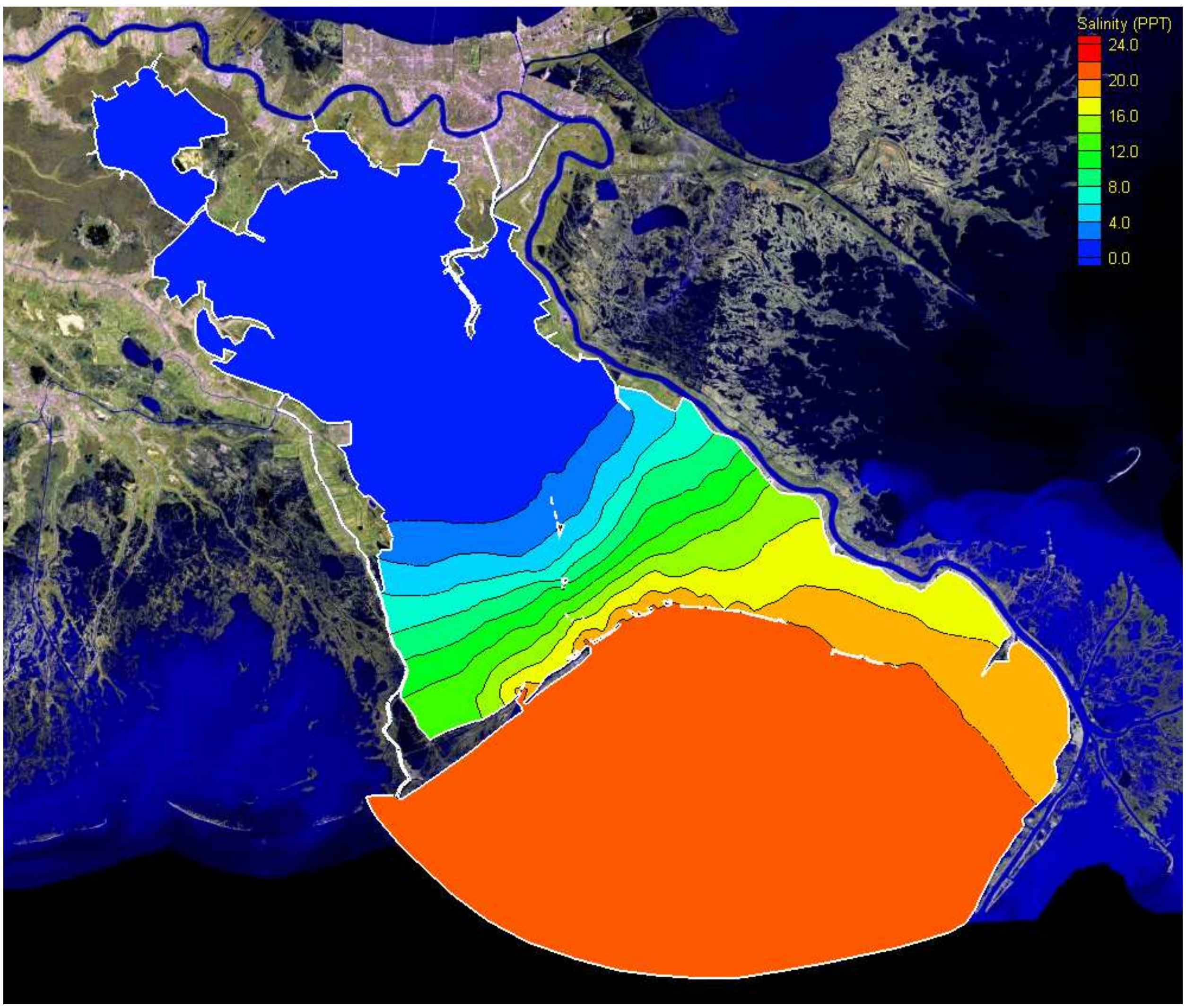


Figure 4.11-1: DHMN Salinity Annually Average

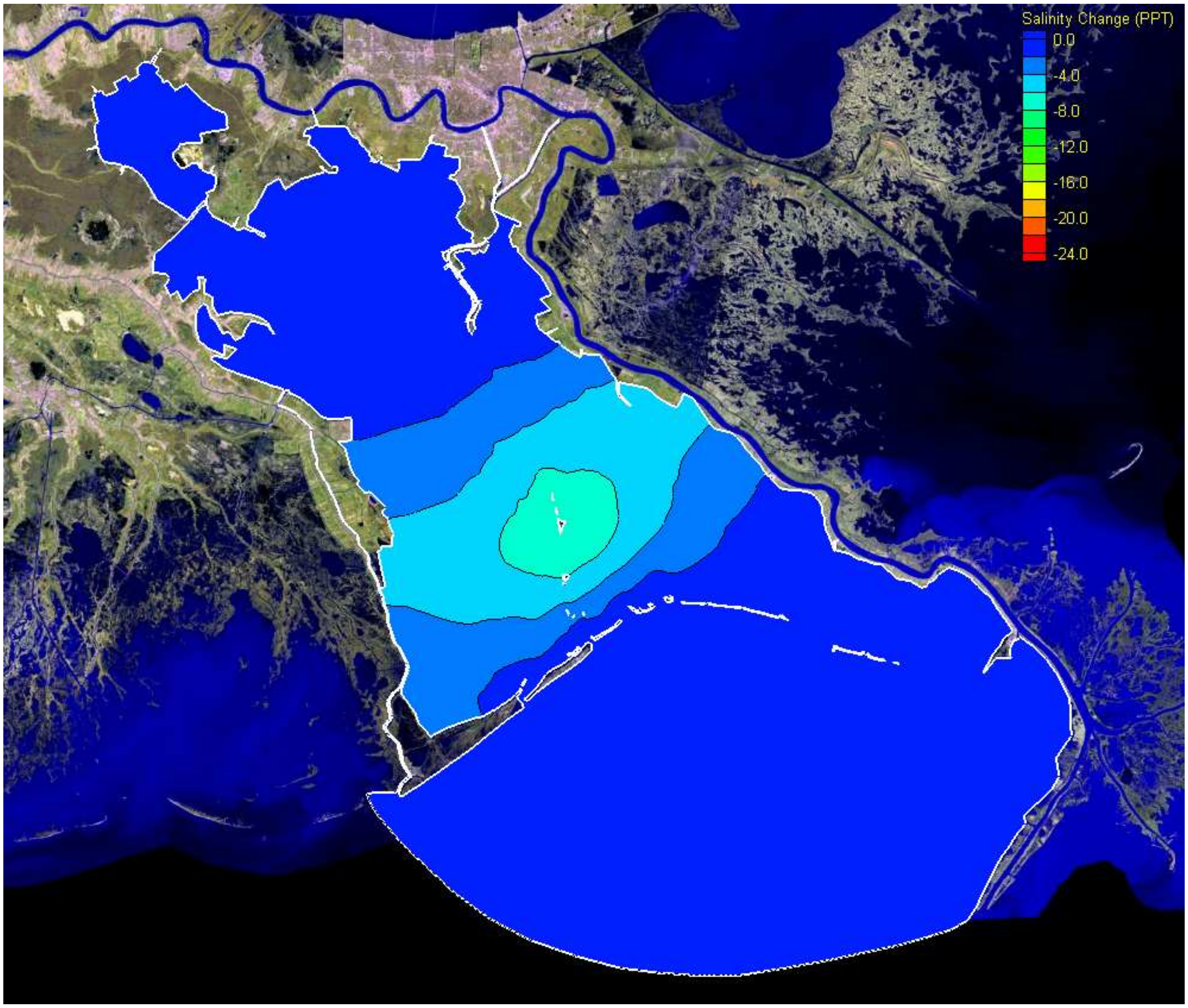


Figure 4.11-2: DHMN Annually Averaged Salinity Change Relative to EXCO

Under the high Davis Pond discharge scenario, the annually averaged salinity was lowered by over 6 ppt in the Barataria Bay. It could reduce the salinity by more than 14 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix L.

4.12 MEDIUM DAVIS POND AND NOMINAL MYRTLE GROVE (DMMN)

This one year model run uses medium discharges at the Davis Pond Diversion and nominal discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.12-1 and Figure 4.12-2, respectively.

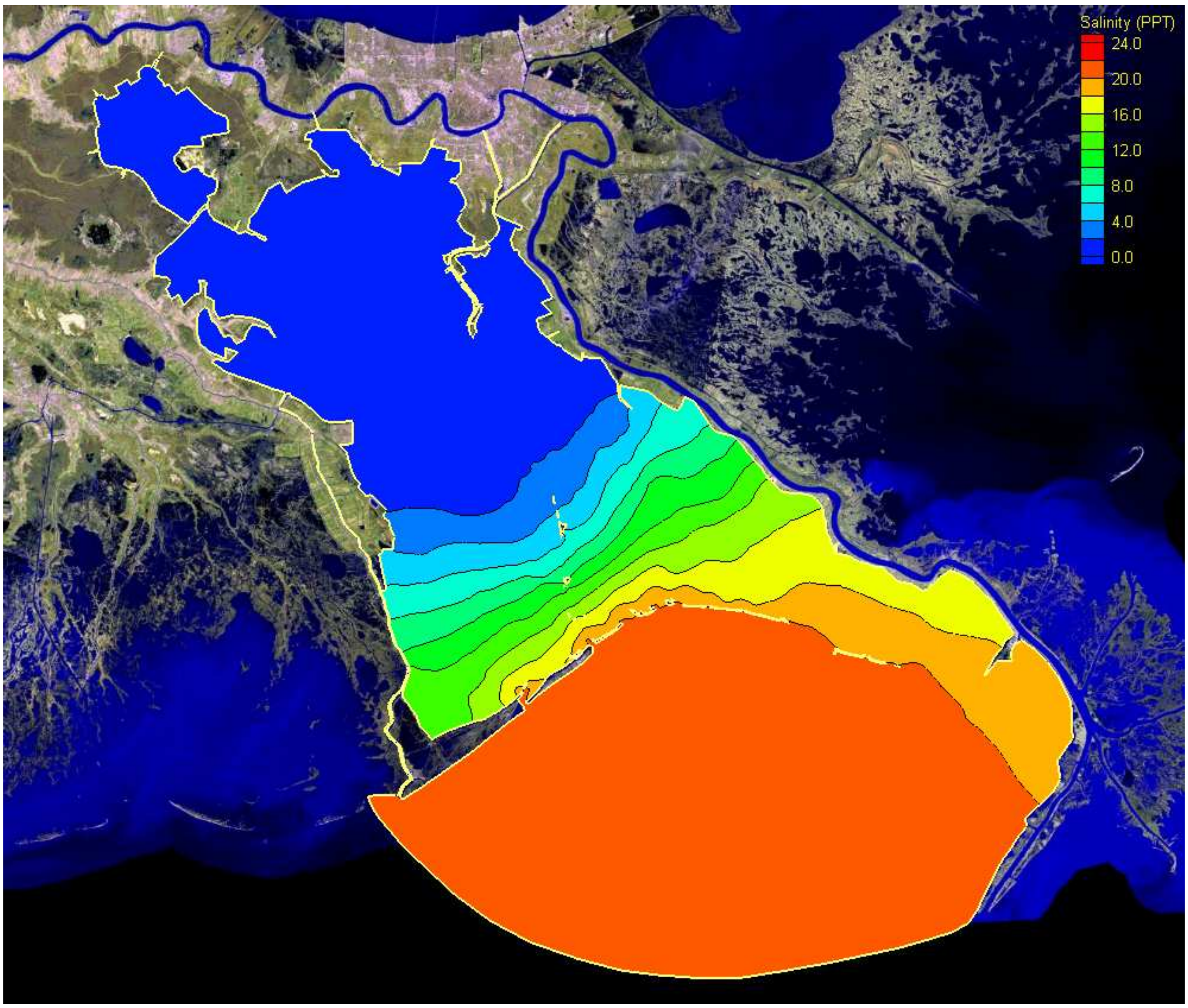


Figure 4.12-1: DMMN Salinity Annually Average

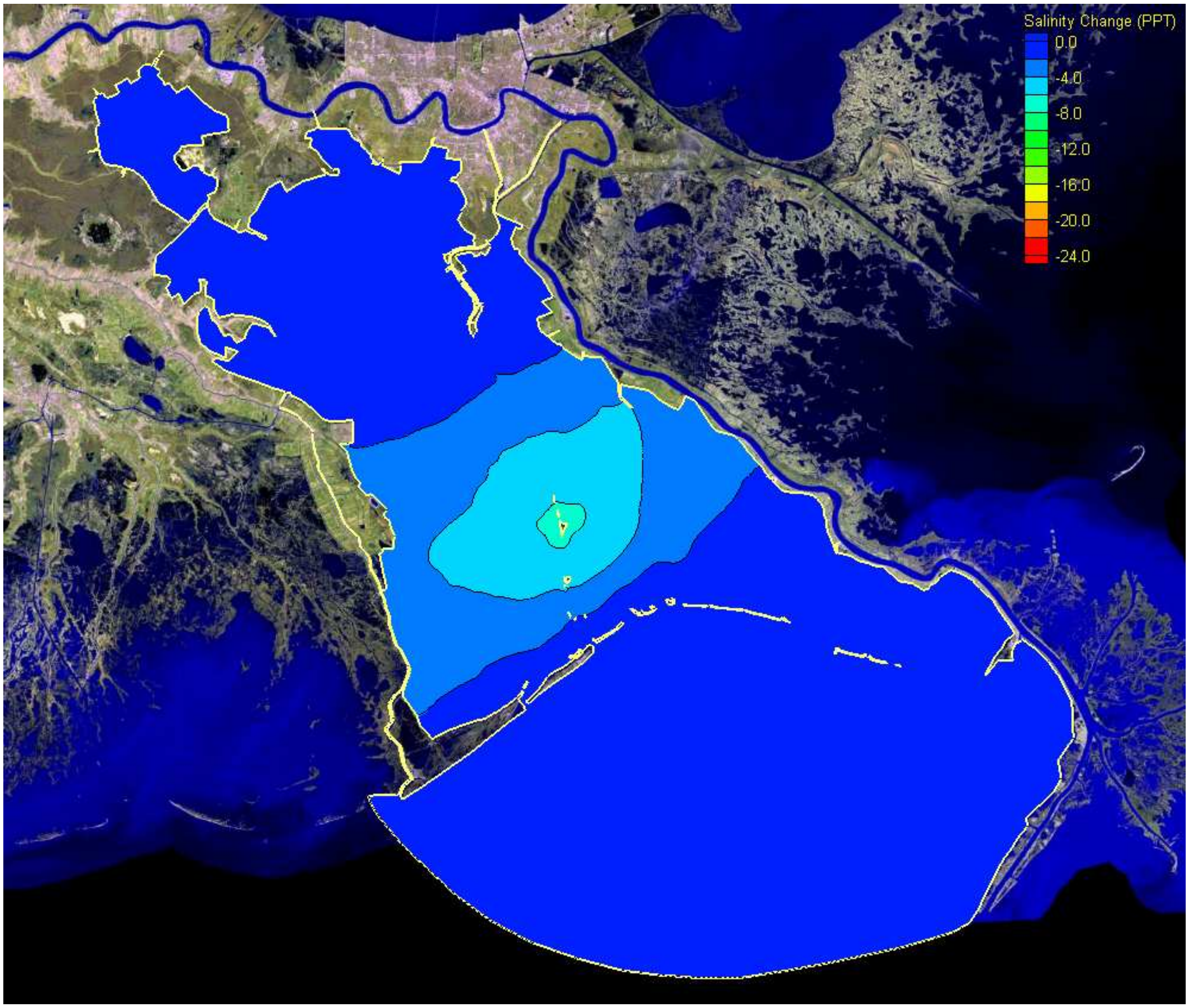


Figure 4.12-2: DMMN Annually Averaged Salinity Change Relative to EXCO

Under medium Davis Pond discharge scenario, the annually averaged salinity was lowered by more than 6 ppt in the Barataria Bay. It could reduce the salinity by more than 12 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix M.

4.13 LOW DAVIS POND AND NOMINAL MYRTLE GROVE (DLMN)

This one year model run uses low discharges at the Davis Pond Diversion and nominal discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.13-1 and Figure 4.13-2, respectively.

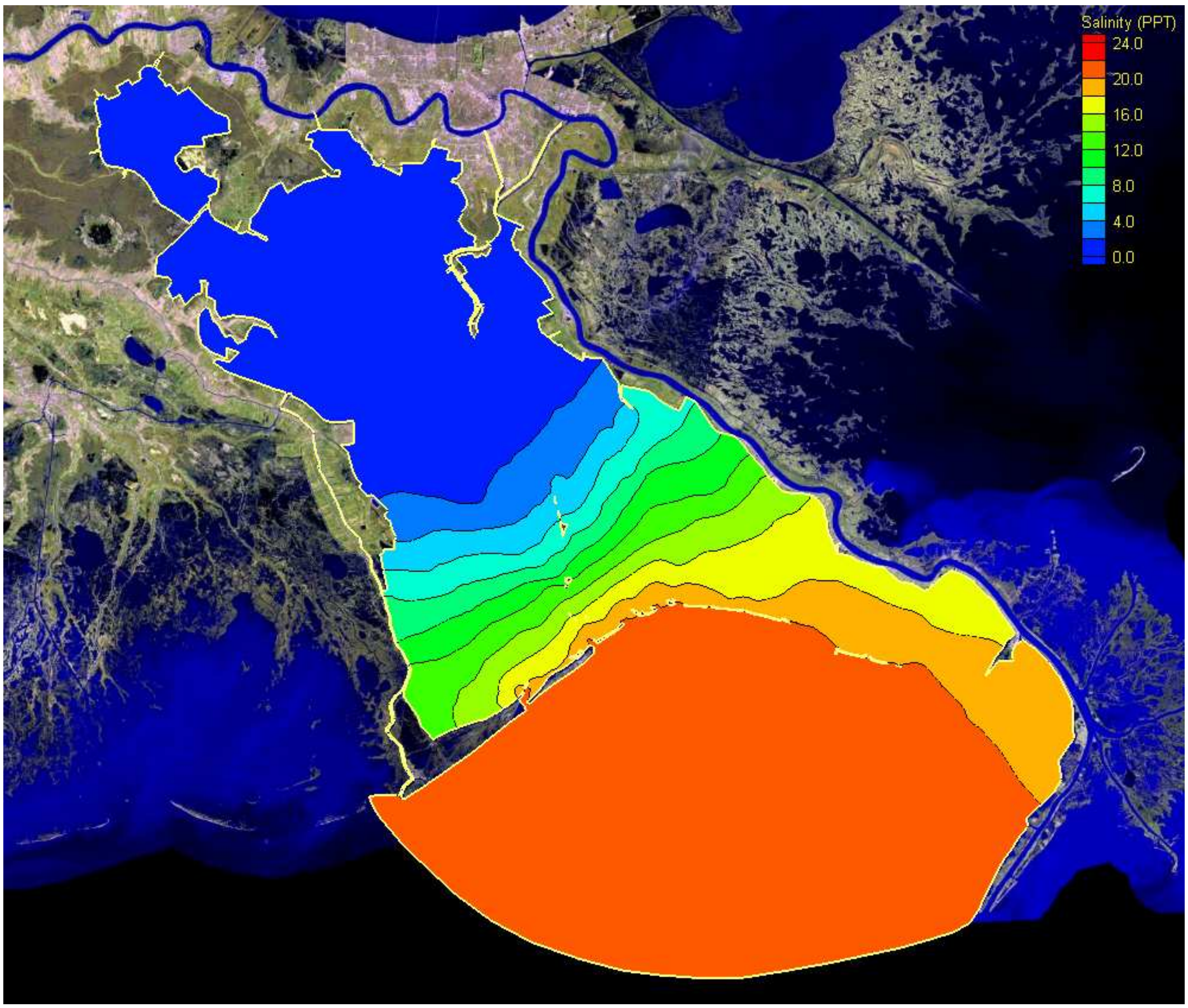


Figure 4.13-1: DLMN Salinity Annually Average

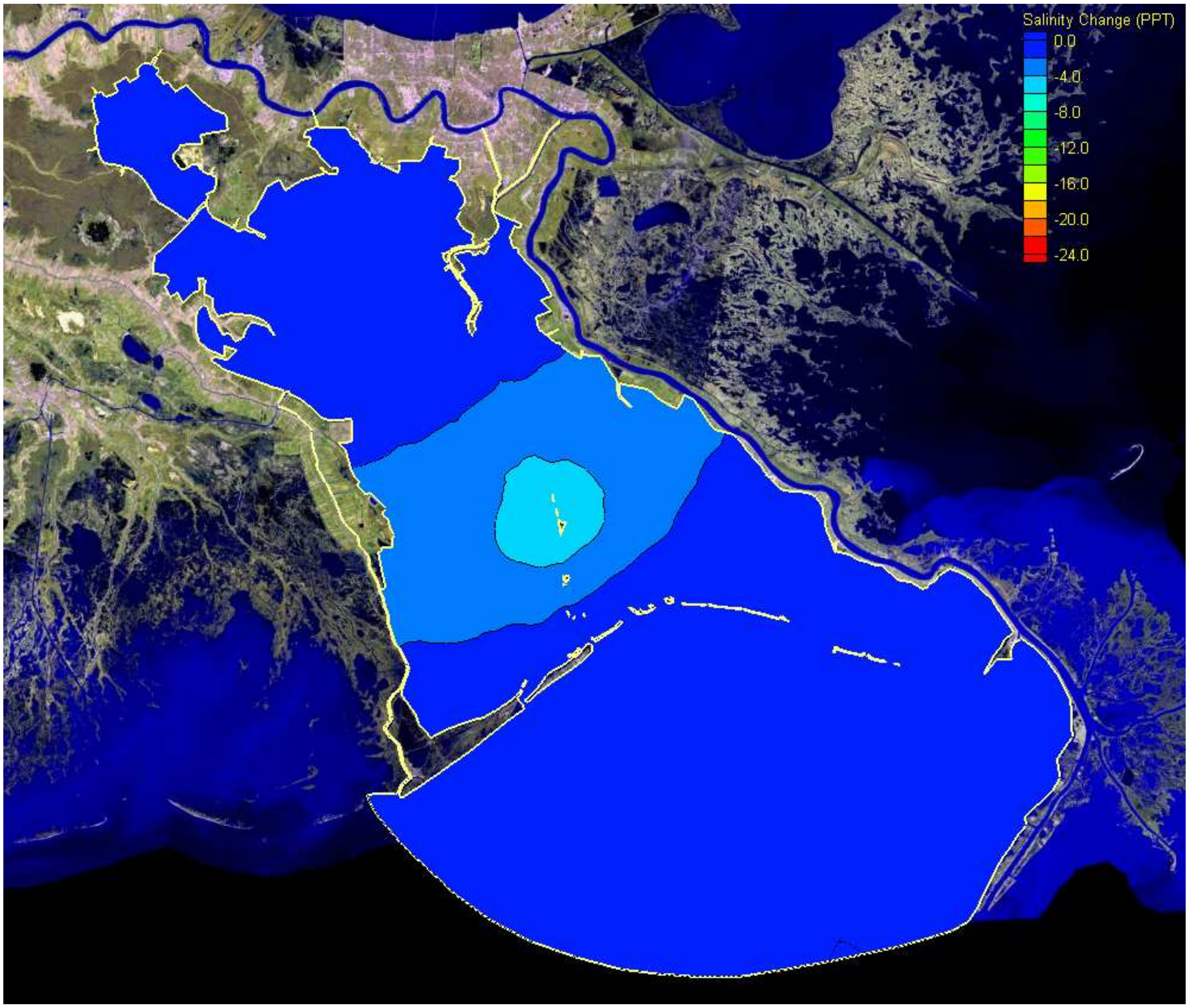


Figure 4.13-2: DLMN Annually Averaged Salinity Change Relative to EXCO

Under low Davis Pond discharge scenario, the annually averaged salinity was lowered by over 4 ppt in the Barataria Bay. It could reduce the salinity by close to 10 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix N.

4.14 HIGH DAVIS POND AND MYRTLE GROVE ALTERNATIVE R1 (DHMR1)

This one year model run uses high discharges at the Davis Pond Diversion and alternative R1 discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.14-1 and Figure 4.14-2, respectively.

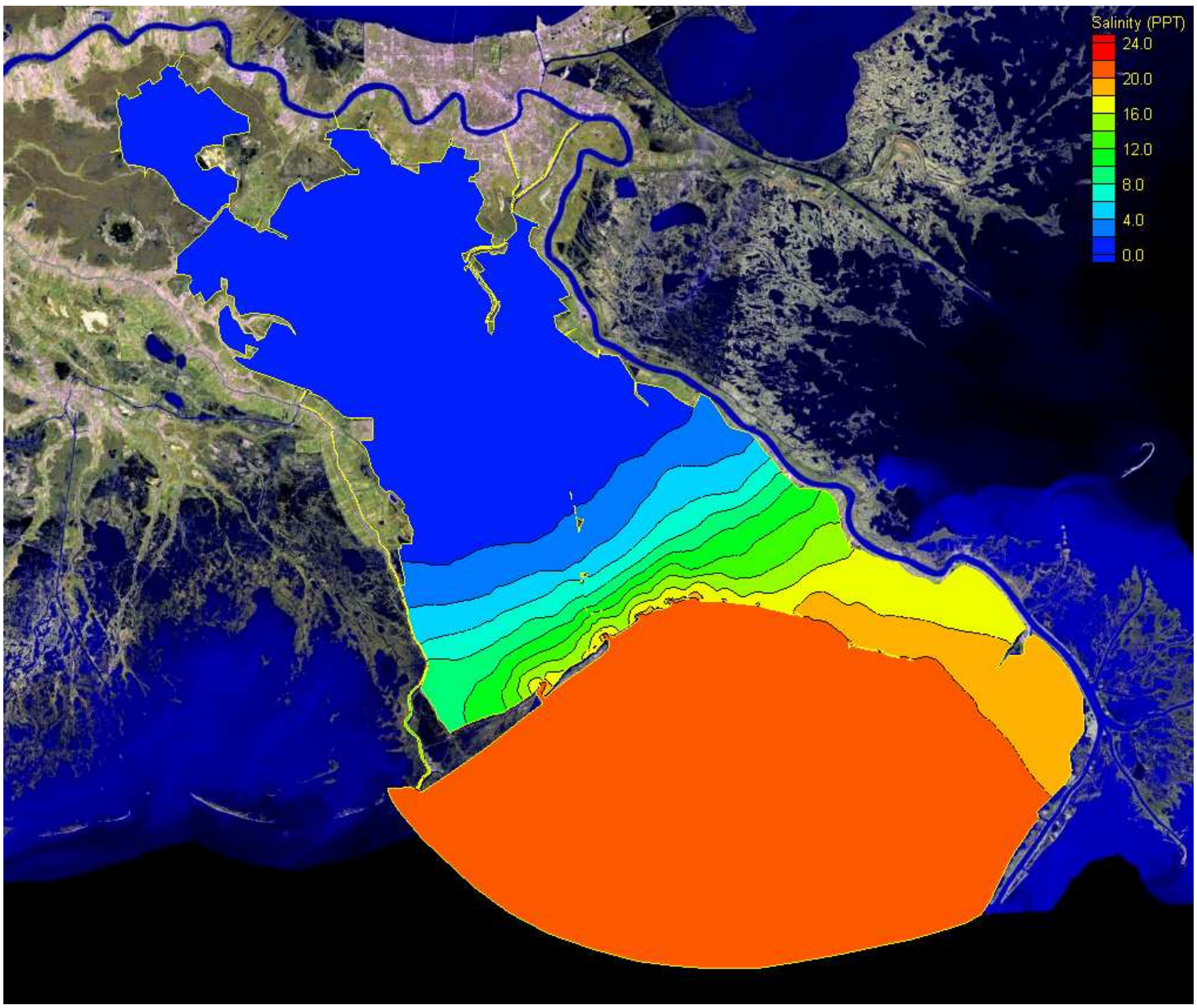


Figure 4.14-1: DHMR1 Salinity Annually Average

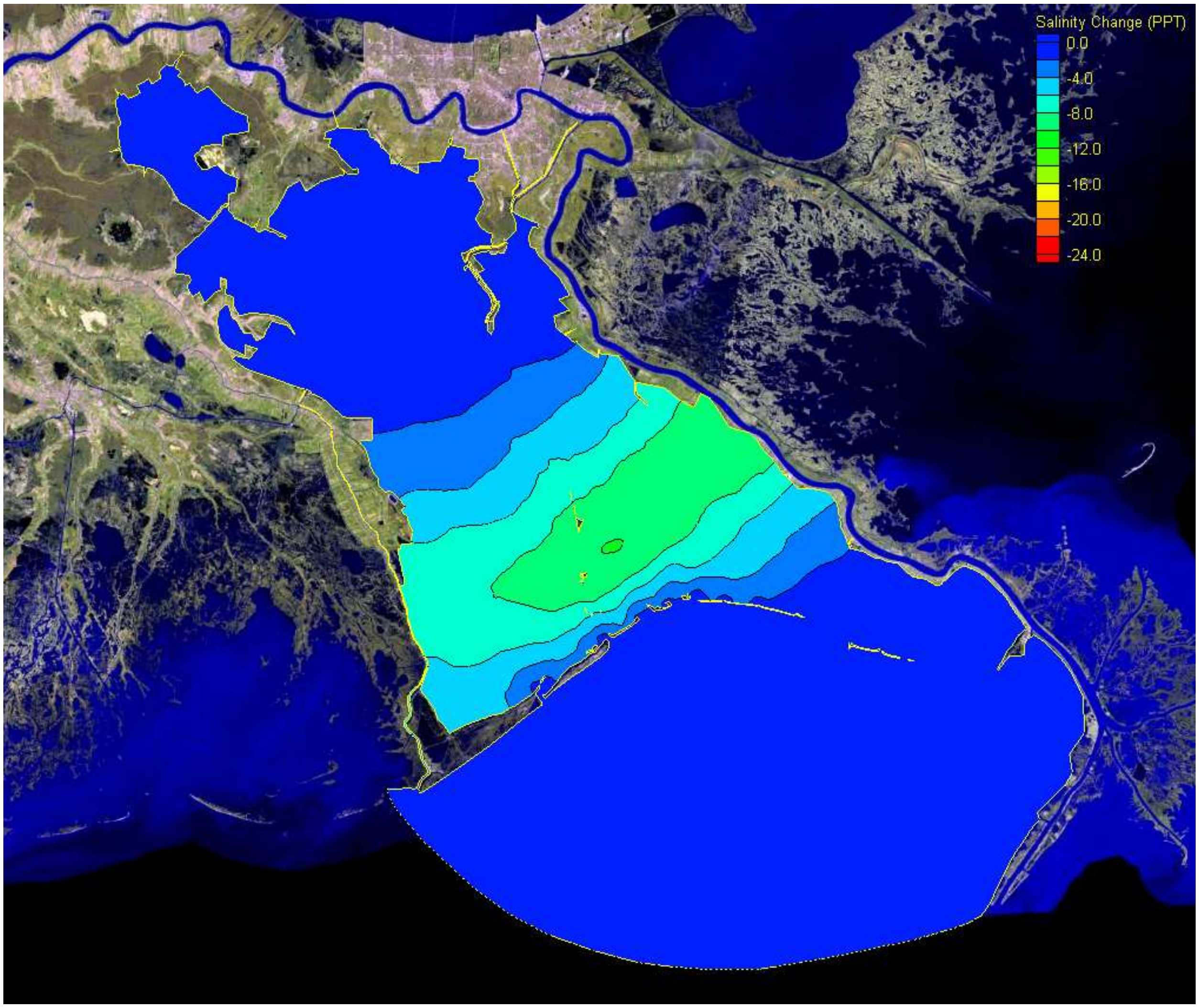


Figure 4.14-2: DHMR1 Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 8 ppt in the Barataria Bay. It could reduce the salinity by more than 20 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix O.

4.15 MEDIUM DAVIS POND AND MYRTLE GROVE ALTERNATIVE R1 (DMMR1)

This one year model run uses medium discharges at the Davis Pond Diversion and alternative R1 discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.15-1 and Figure 4.15-2, respectively.

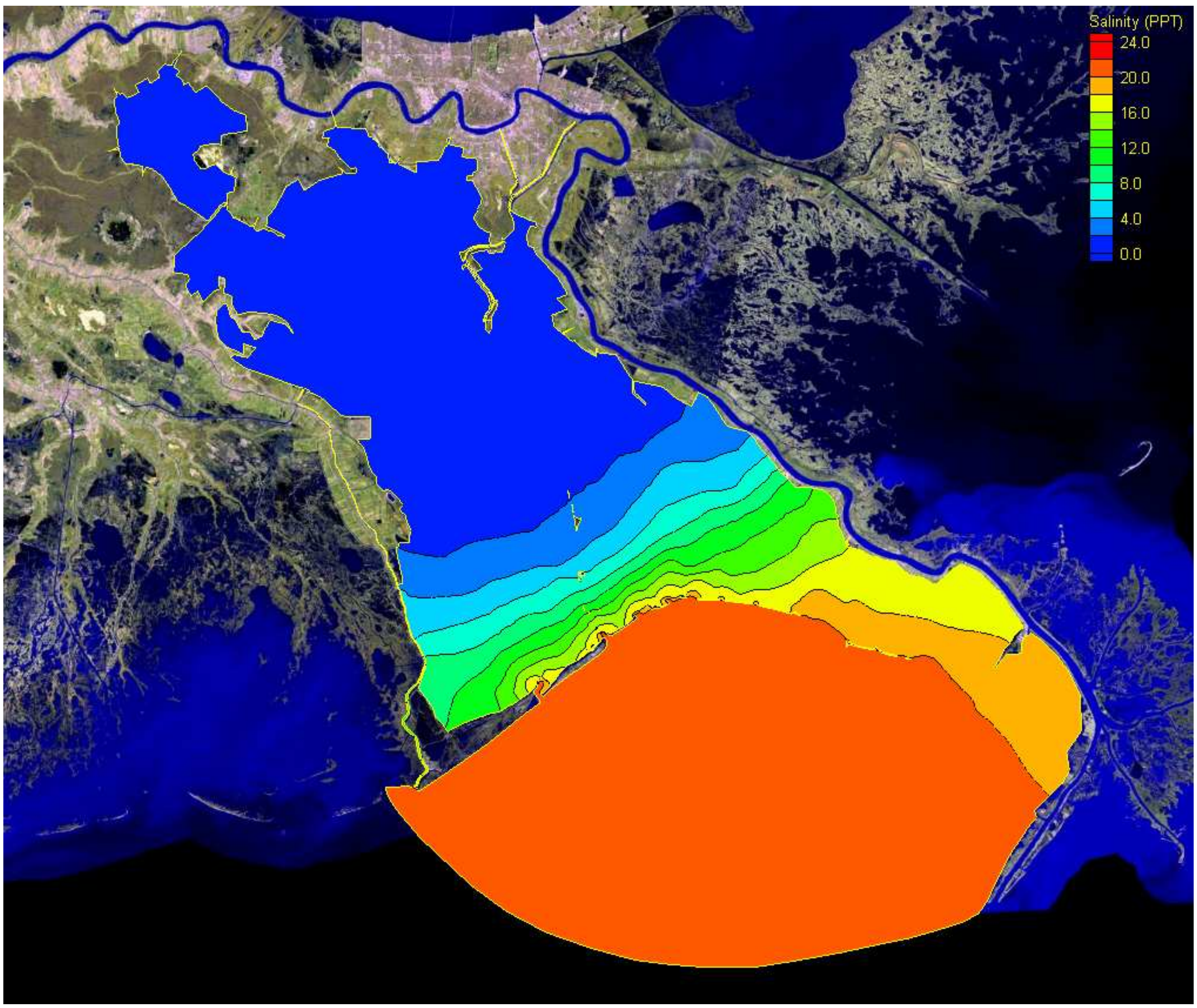


Figure 4.15-1: DMMR1 Salinity Annually Average

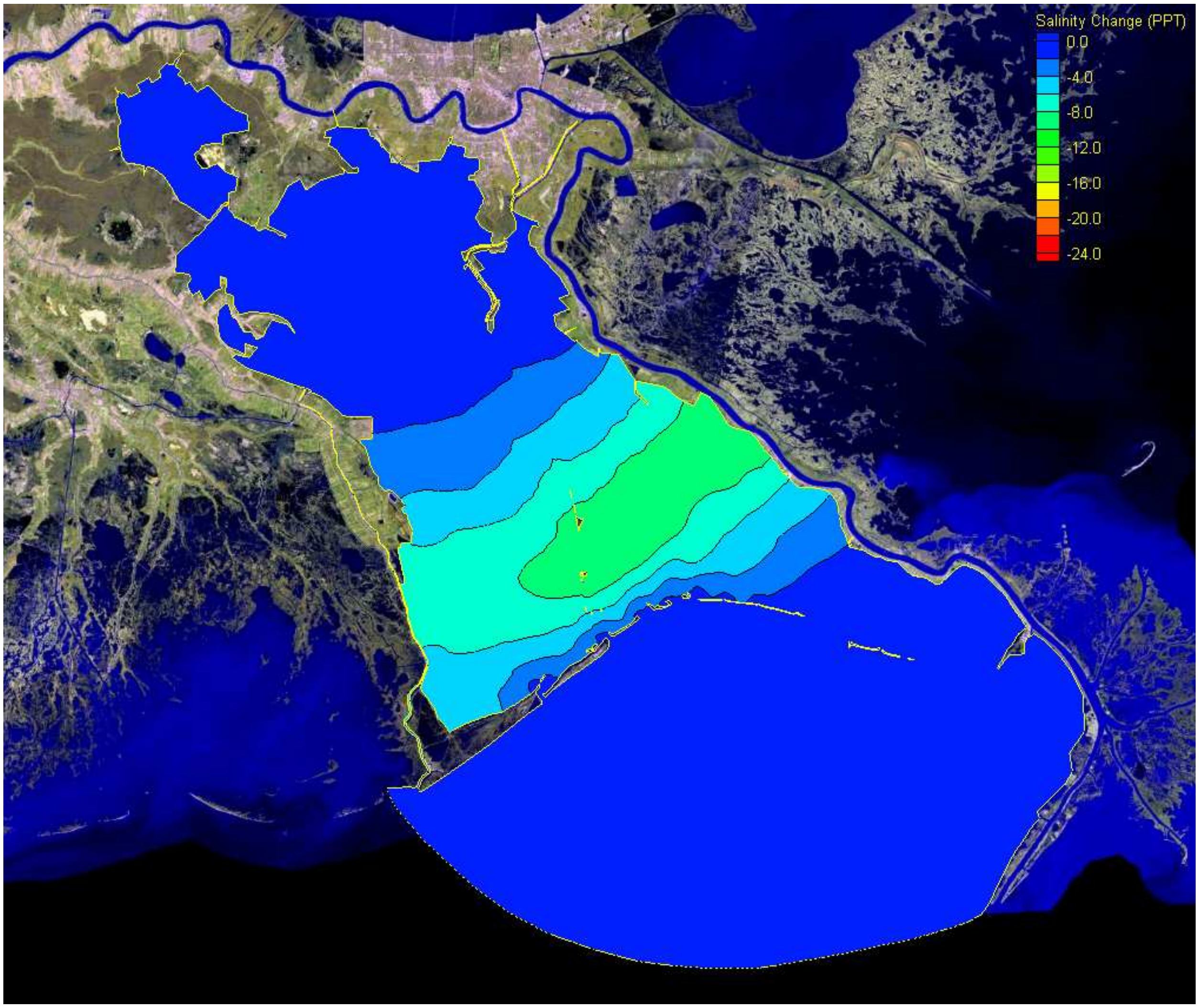


Figure 4.15-2: DMMR1 Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 8 ppt in the Barataria Bay. It could reduce the salinity by more than 20 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix P.

4.16 LOW DAVIS POND AND MYRTLE GROVE ALTERNATIVE R1 (DLMR1)

This one year model run uses low discharges at the Davis Pond Diversion and alternative R1 discharges at the Myrtle Grove Diversion. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.16-1 and Figure 4.16-2, respectively.

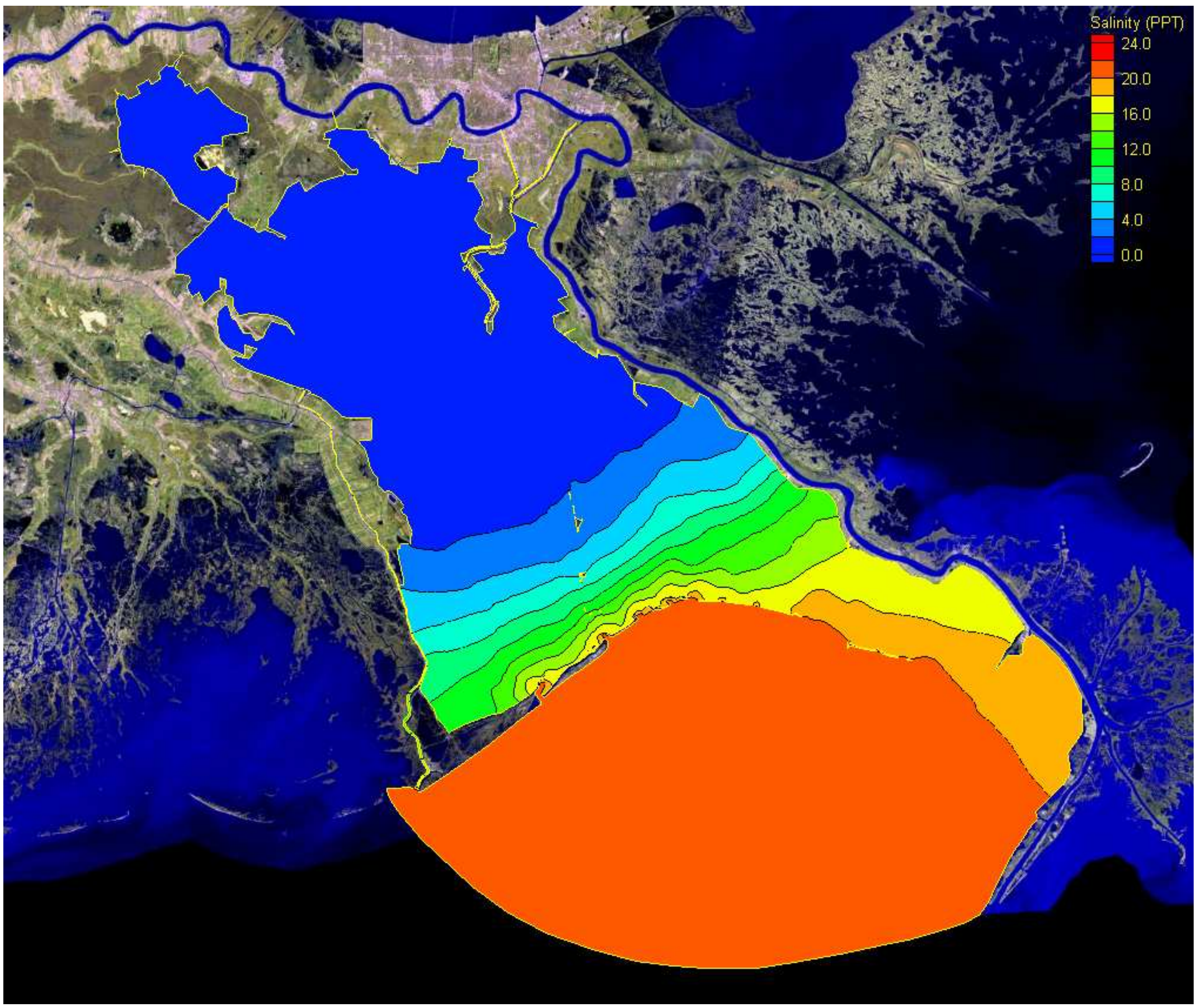


Figure 4.16-1: DLMR1 Salinity Annually Average

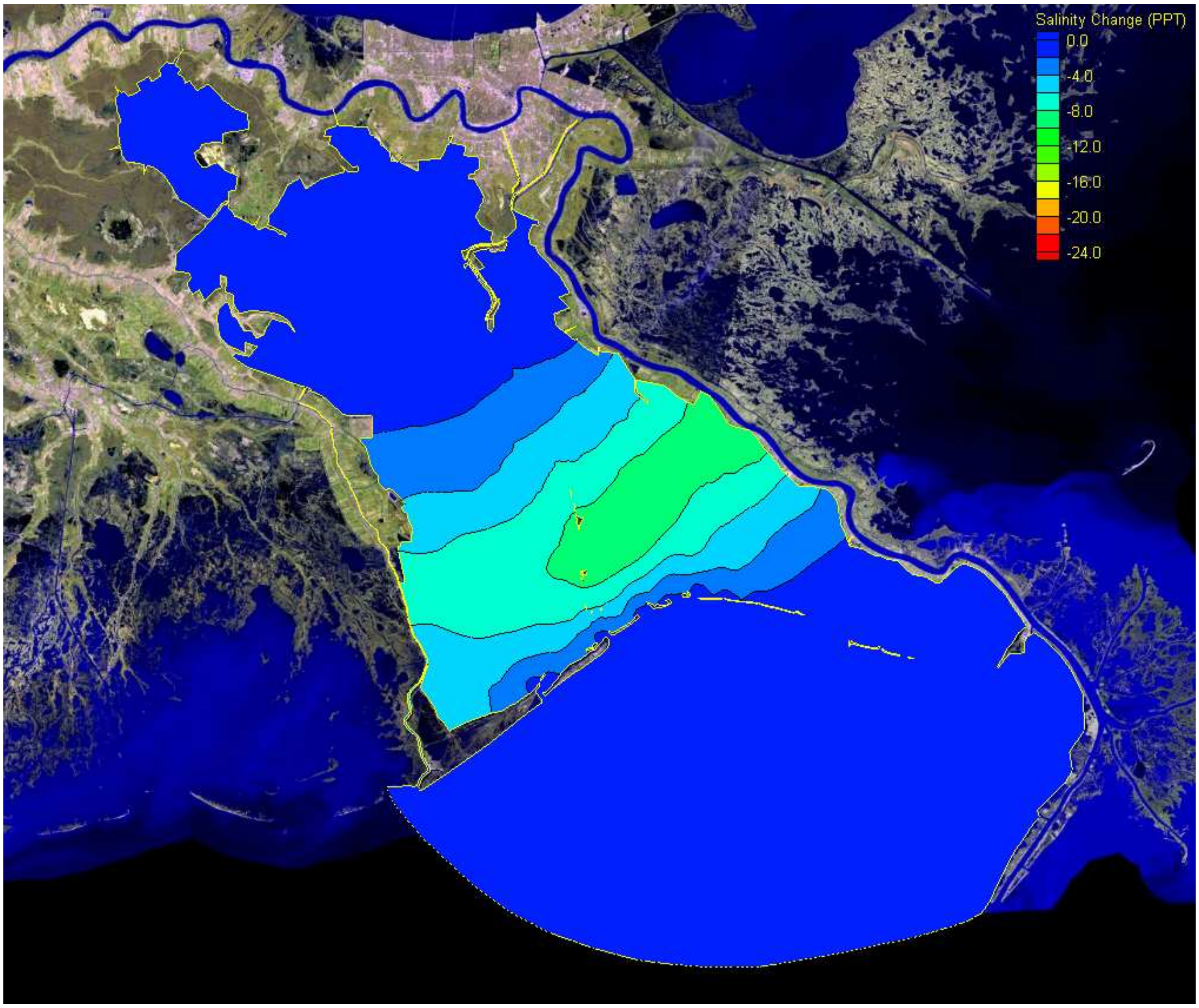


Figure 4.16-2: DLMR1 Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 8 ppt in the Barataria Bay. It could reduce the salinity by more than 20 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix Q.

4.17 HIGH DAVIS POND AND DOUBLE-HIGH MYRTLE GROVE (DHM2H)

This additional one year model run uses high discharges at the Davis Pond Diversion and double the high discharges at the Myrtle Grove Diversion. This purpose of this run is to investigate the salinity change under higher Myrtle Grove diversion discharges. Only the combination with high Davis Pond discharges was performed. The maximum discharge is close to the Alternative R1 case. The annually averaged salinity level and the changes relative to the existing condition are shown in Figure 4.17-1 and Figure 4.17-2, respectively.

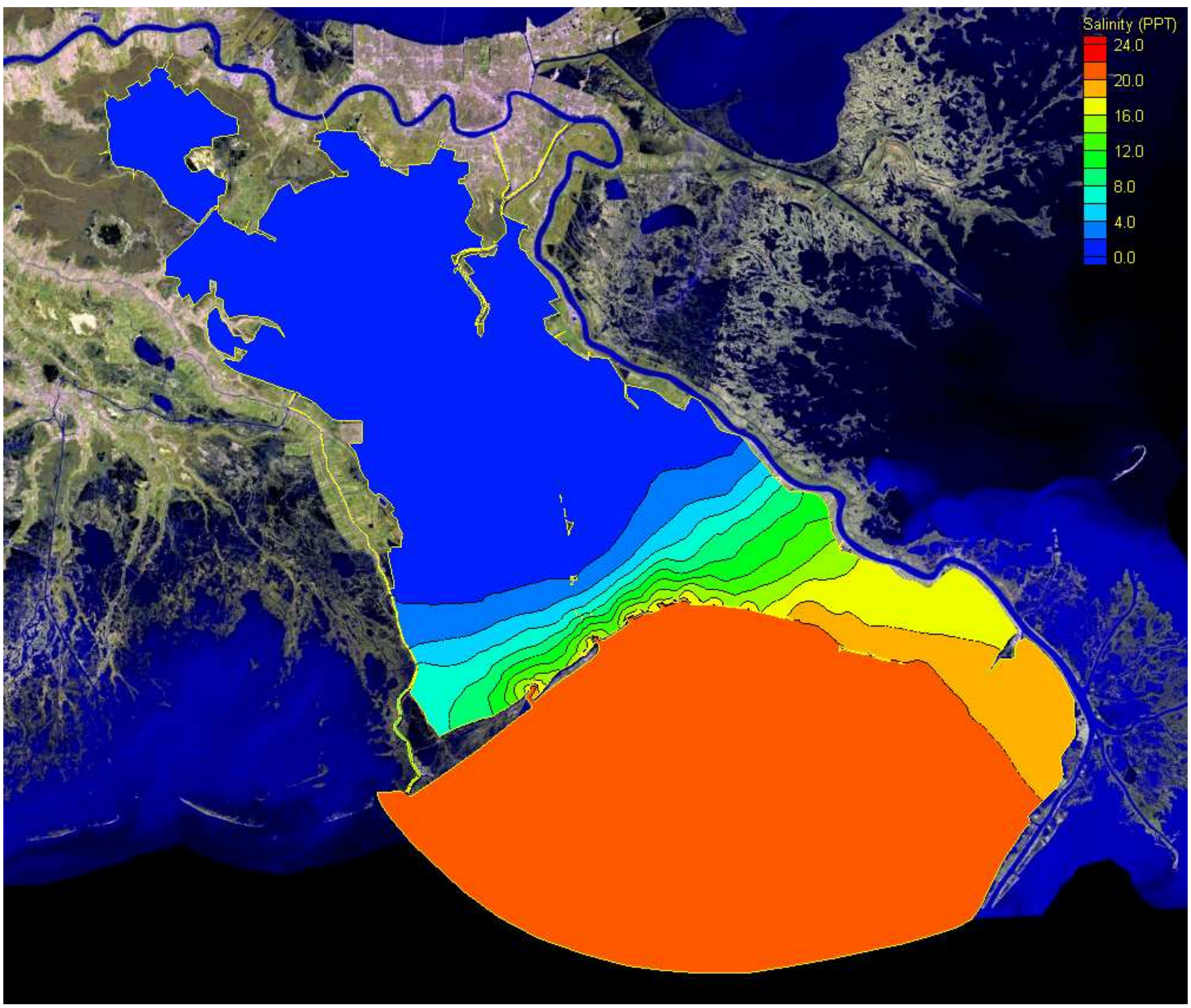


Figure 4.17-1: DHM2H Salinity Annually Average

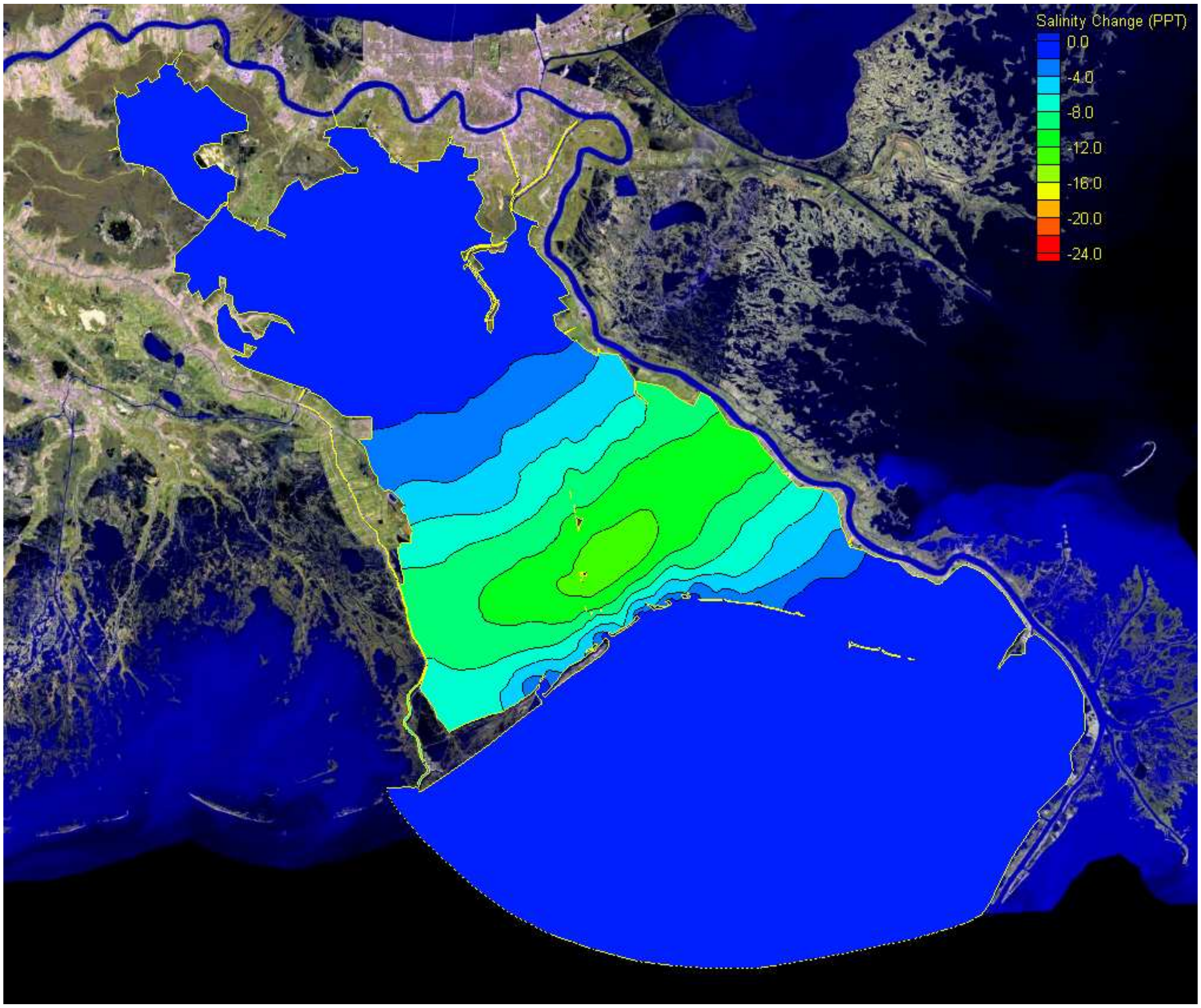


Figure 4.17-2: DHM2H Annually Averaged Salinity Change Relative to EXCO

Under this discharge combination scenario, the annually averaged salinity was lowered by more than 12 ppt in the Barataria Bay. It could reduce the salinity by more than 20 ppt at some locations during the year as illustrated in the monthly averaged results in Appendix R.

4.18 MYRTLE GROVE PROJECT EFFECTS

To further investigate the relative effects of the Myrtle Grove project on the salinity level in the basin, salinity change comparisons were made by subtracting salinity results of the twelve year-long pre-screening level alternative model runs from the three nominal Myrtle Grove discharge cases. These results are then the relative impact of the Myrtle Grove Diversion on basin salinities. The relative annually averaged salinity change for the four Myrtle Grove discharge cases given the three different diversion scenarios at Davis Pond are shown from Figures 4.18-1 to 4.18-4.

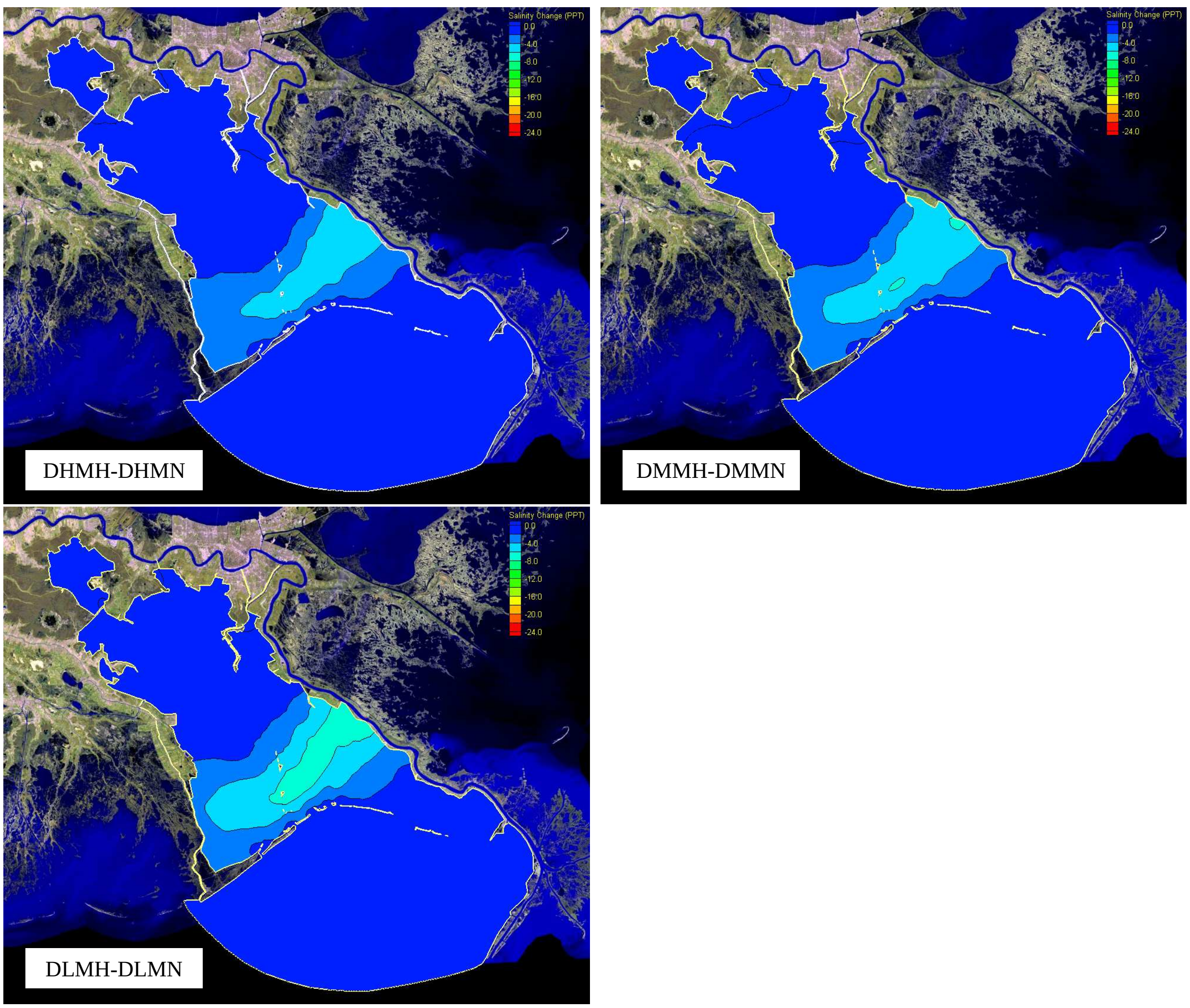


Figure 4.18-1: Salinity Annually Average Change Comparisons for High Myrtle Grove Diversion with Three Different Davis Pond Diversions

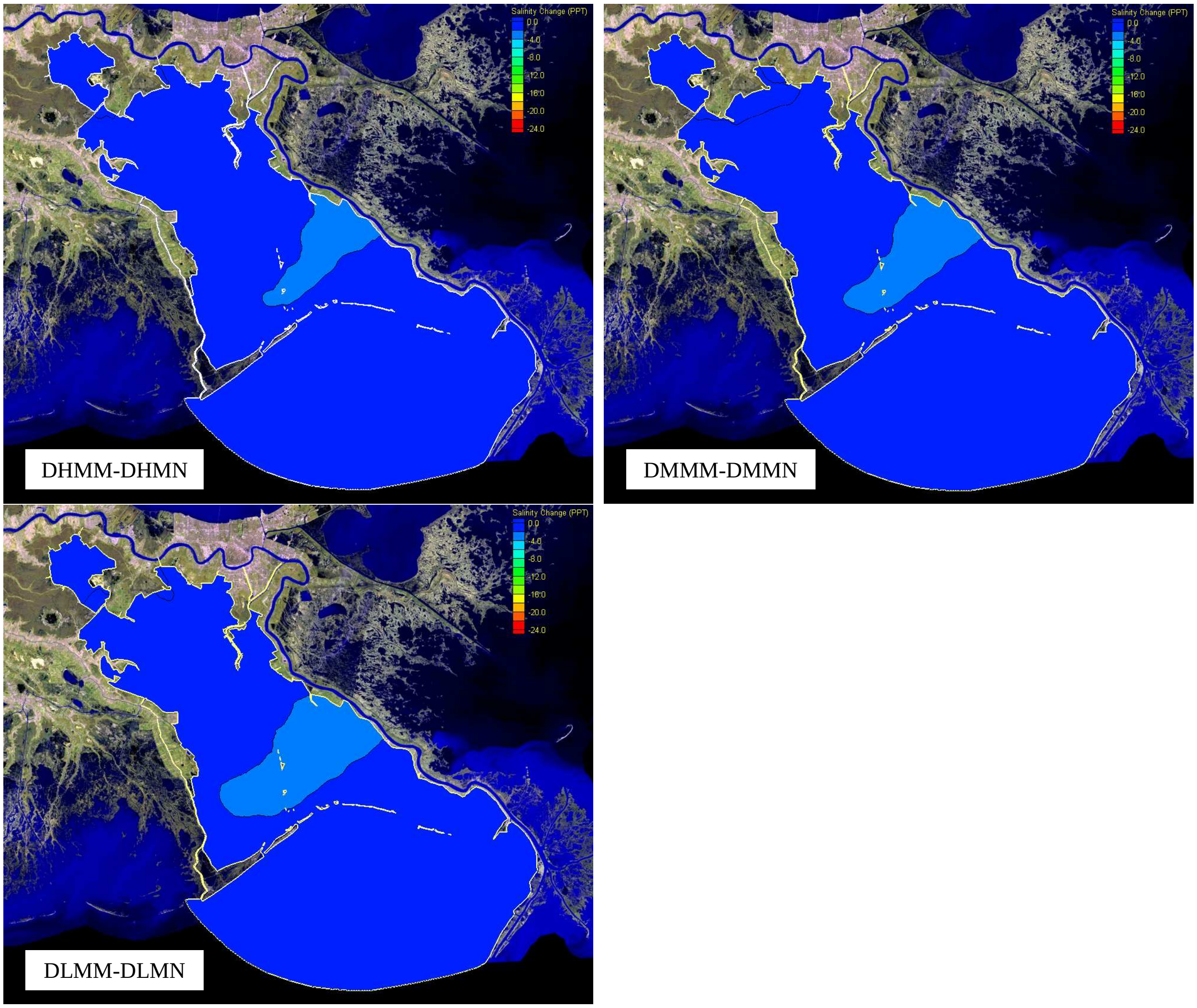


Figure 4.18-2: Salinity Annually Average Change Comparisons for Medium Myrtle Grove Diversion with Three Different Davis Pond Diversions

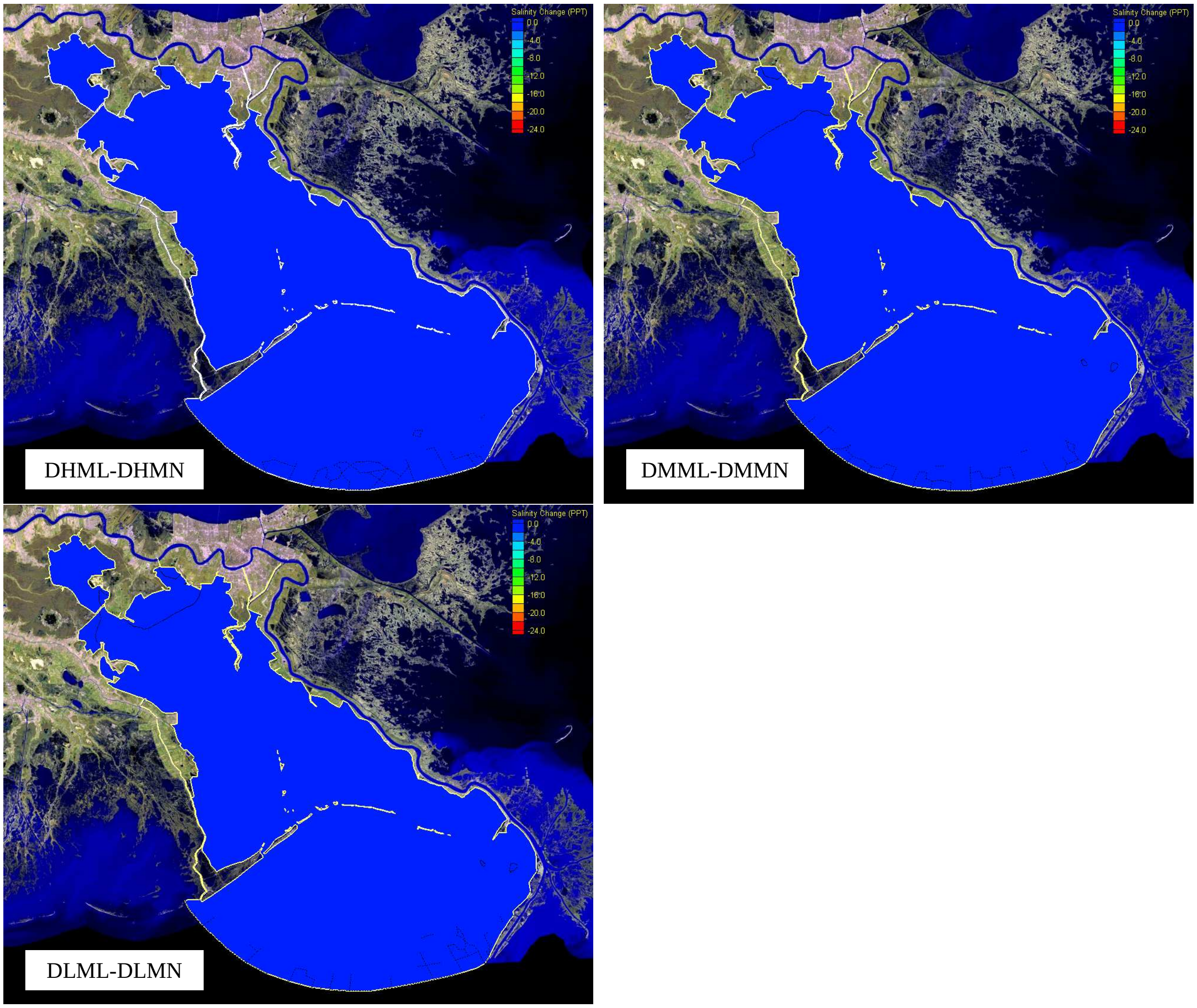


Figure 4.18-3: Salinity Annually Average Change Comparisons for Low Myrtle Grove Diversion with Three Different Davis Pond Diversions

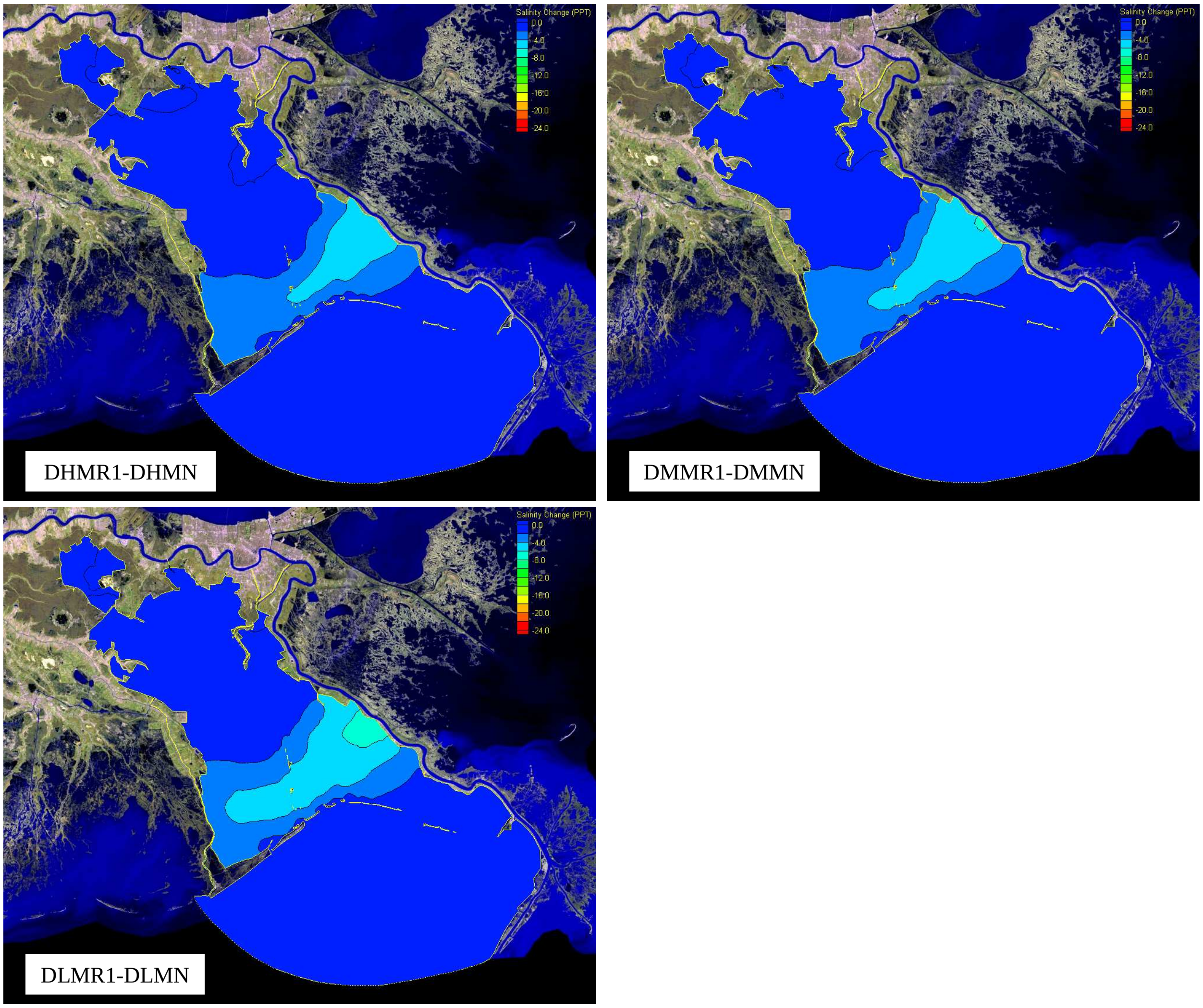


Figure 4.18-4: Salinity Annually Average Change Comparisons for R1 Myrtle Grove Diversion with Three Different Davis Pond Diversions

Monthly results are included in Appendix S for the high Myrtle Grove discharge comparisons. Salinity change comparisons for the medium, low and R1 Myrtle Grove discharge cases are shown in Appendices T, U and V respectively.

The results show that the relative effects on salinity levels in the basin of a high diversion at Myrtle Grove project are significantly reduced when a higher diversion regime at Davis Pond is operated. A high Myrtle Grove diversion would reduce annually averaged salinity level at some locations during the year by over 6 ppt under a low diversion at Davis Pond. The effects are significantly reduced in area under the medium diversion scenario at Davis Pond, and reductions are limited to just over 4 ppt under the high Davis Pond diversion scenario.

Generally, a medium Myrtle Grove diversion reduces salinities in the basin by just over 2 ppt, while under the low Myrtle Grove diversion scenario salinity levels in the basin are reduced less than 1 ppt, regardless of the Davis Pond Diversion operational level.

The 5 ppt and 15 ppt contour lines were also investigated to demonstrate the impact of different Myrtle Grove diversions. Figures 4.18-5 to 4.18-7 show the annually averaged results under the three different operational Davis Pond diversions. If a high Myrtle Grove diversion is used, the 5 ppt and 15 ppt contour lines retreat to south by about 4 miles and 1.5 miles, respectively more than no Myrtle Grove diversion under a high Davis Pond diversion rate. The retreats would be about 4.5 miles and 2 miles under a medium Davis Pond diversion, and increase to 6 miles and 2.5 miles under a low Davis Pond diversion. However if a medium Myrtle Grove diversion is used, the retreats would reduce to about half the distance of high Myrtle Grove diversion case, while the low Myrtle Grove diversion shows little impact on the salinity levels in the basin. If a much higher Myrtle Grove diversion like the R1 case is used, the annual retreats show no improvements over the high Myrtle Grove case because there is no discharge during the half year period of June to November for the R1 scenario. However, the double-high Myrtle Grove diversion does show greater annual salinity retreats (Figure 4.18-5).

Figures 4.18-8 to 4.18-10 show the semi-annually (December – May) averaged results under the three different operational Davis Pond diversions. The salinity contours retreat further to the south under the R1 Myrtle Grove diversion than the high Myrtle Grove diversion case.

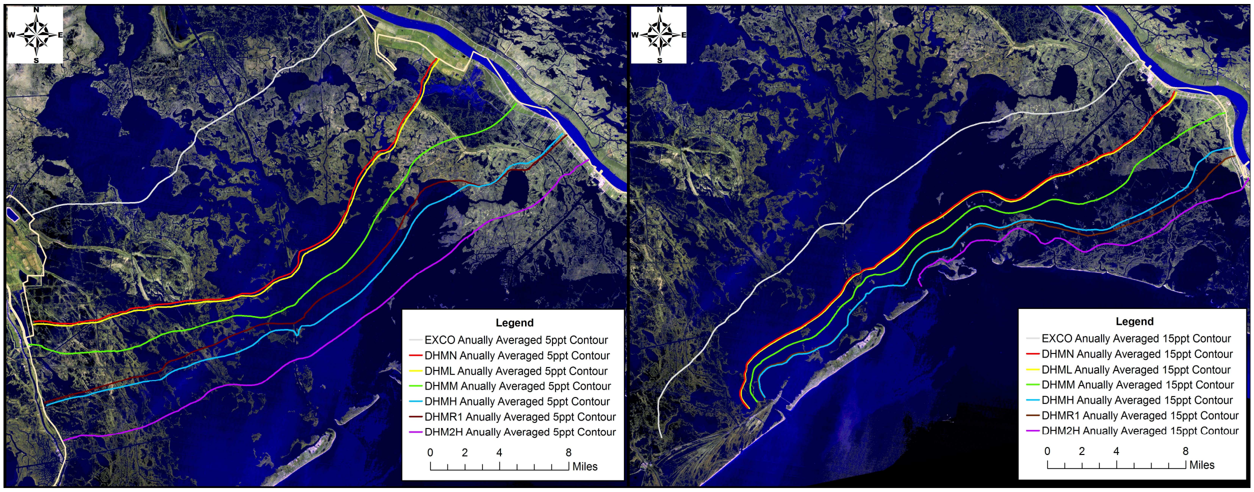


Figure 4.18-5: Annually Averaged Contour Changes under High Davis Pond Diversion Rate for different Myrtle Grove Diversions

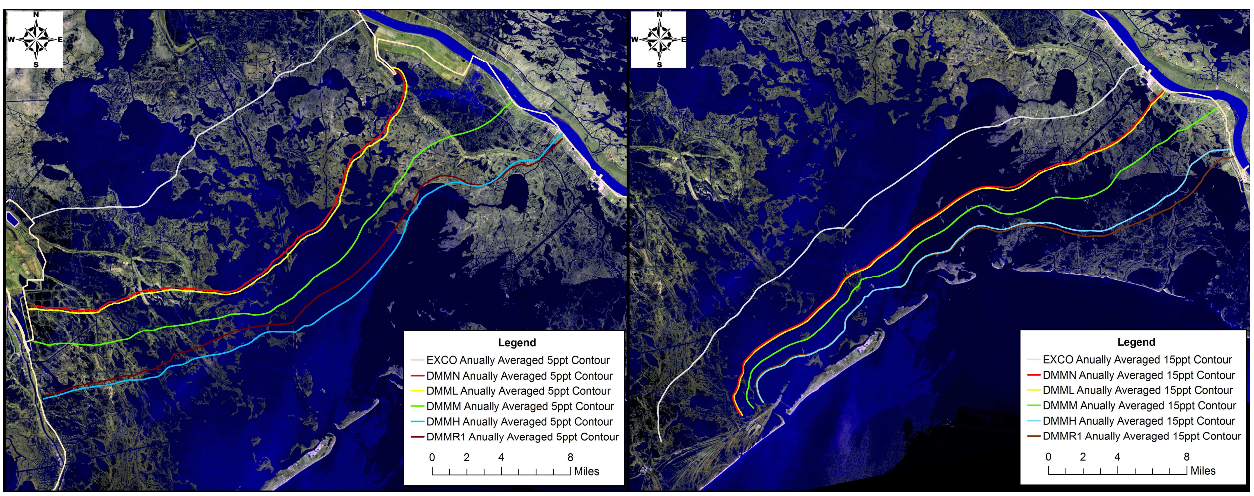


Figure 4.18-6: Annually Averaged Contour Changes under Medium Davis Pond Diversion Rate for different Myrtle Grove Diversions

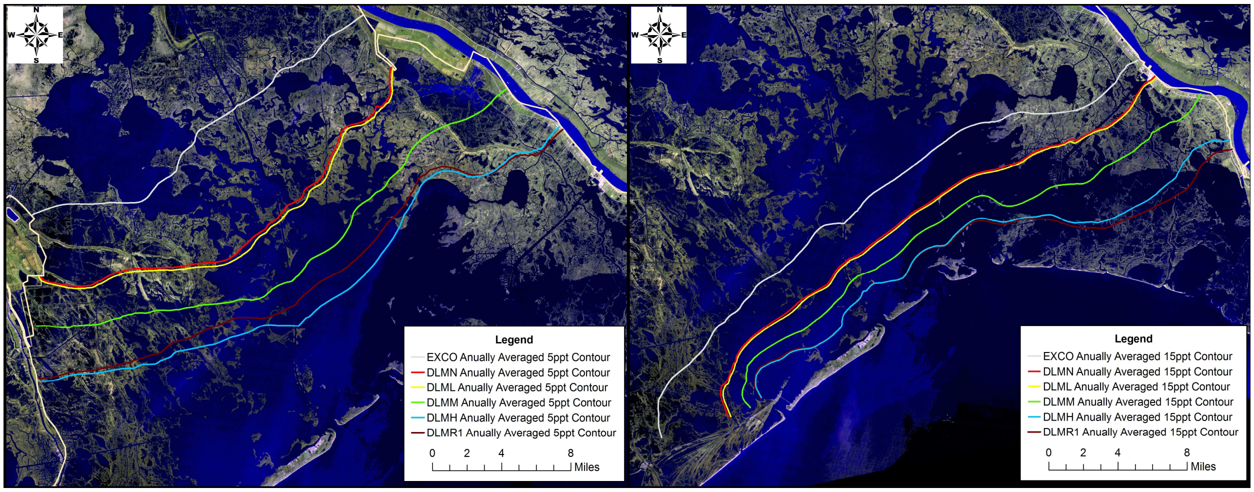


Figure 4.18-7: Annually Averaged Contour Changes under Low Davis Pond Diversion Rate for different Myrtle Grove Diversions

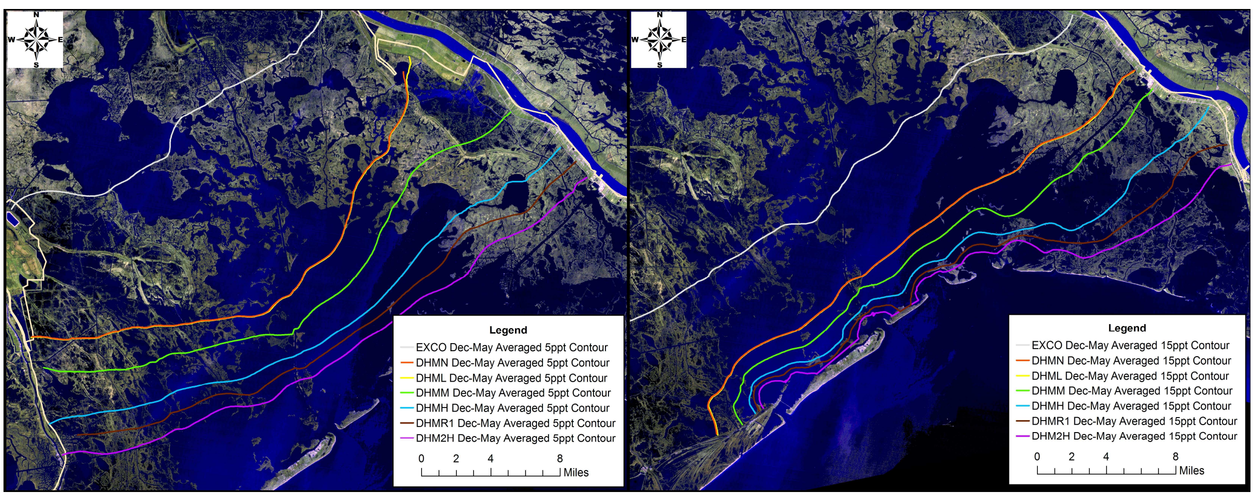


Figure 4.18-8: Semi-Annually Averaged Contour Changes under High Davis Pond Diversion Rate for different Myrtle Grove Diversions

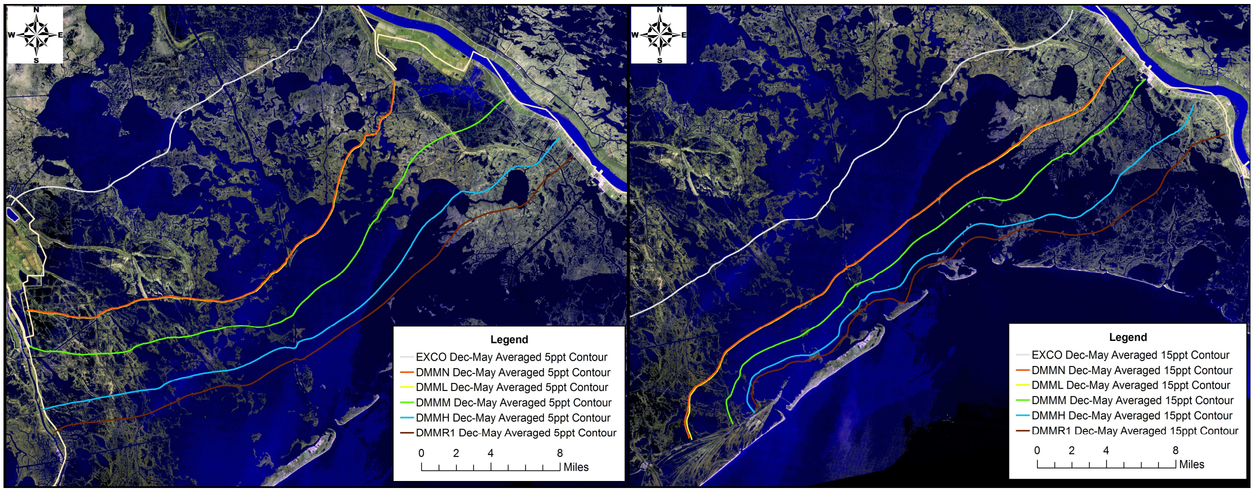


Figure 4.18-9: Semi-Annually Averaged Contour Changes under Medium Davis Pond Diversion Rate for different Myrtle Grove Diversions

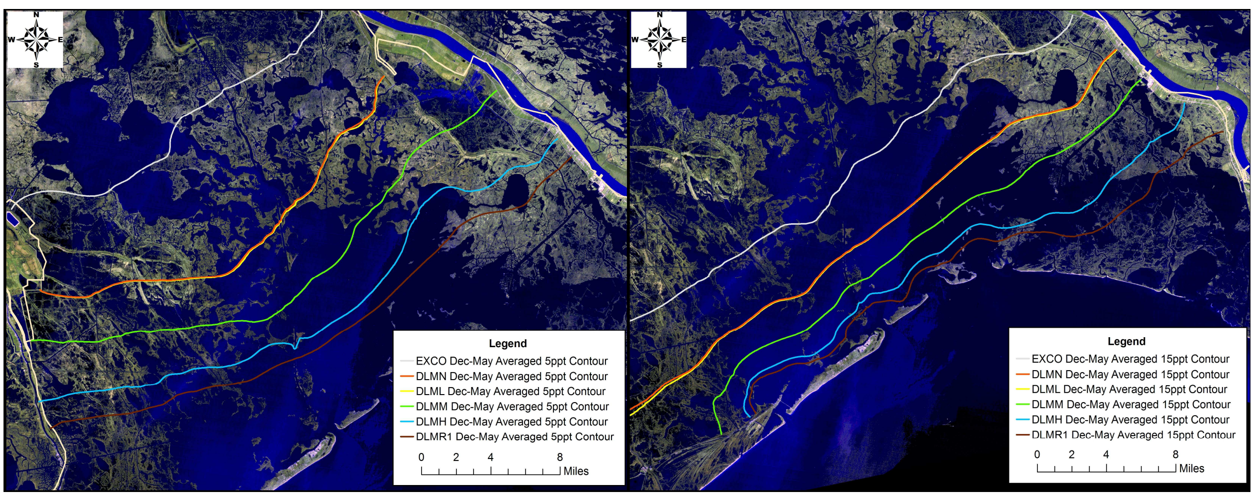


Figure 4.18-10: Semi-Annually Averaged Contour Changes under Low Davis Pond Diversion Rate for different Myrtle Grove Diversions

4.19 HYDRODYNAMICS RESULTS INVESTIGATION

In this section, the hydrodynamics results, the driving force of salinity diffusion, were examined. For water surface elevations, average, minimum and maximum values were calculated from RMA2 results. For currents, average and maximum velocity magnitudes were determined.

The semi-annually (December – May) results from two high Myrtle Grove diversion cases, DHMH and DHMR1, and the changes relative to the existing conditions, EXCO, were calculated and presented below.

Figure 4.19-1 shows the water surface elevation results for the existing condition. The semi-annually averaged water surface elevation is between 0.6 ft and 0.8 ft, while the minimum value is from -0.2 ft to -1 ft offshore, and the maximum value is from 2 ft offshore to almost 3 ft in the upper North region.

Figures 4.19-2 to 4.19-4 demonstrate the semi-annual average, minimum and maximum water surface elevation results for DHMH and DHMR1 and their differences with EXCO, respectively. The water surface elevation changes caused by the Davis Pond and Myrtle Grove diversions become apparent north of Little Lake and more predominant near the diversions. More diversion from Myrtle Grove in DHMR1 causes more water surface elevation increase than DHMH near the diversion site.

Figure 4.19-5 gives the semi-annual current velocity magnitude results for the existing condition, and Figures 4.19-6 to 4.19-7 present the average and maximum velocity magnitude for DHMH and DHMR1 and the changes relative to EXCO, respectively. The effects of the diversions to the currents are only relevant to the region adjacent to the sites.

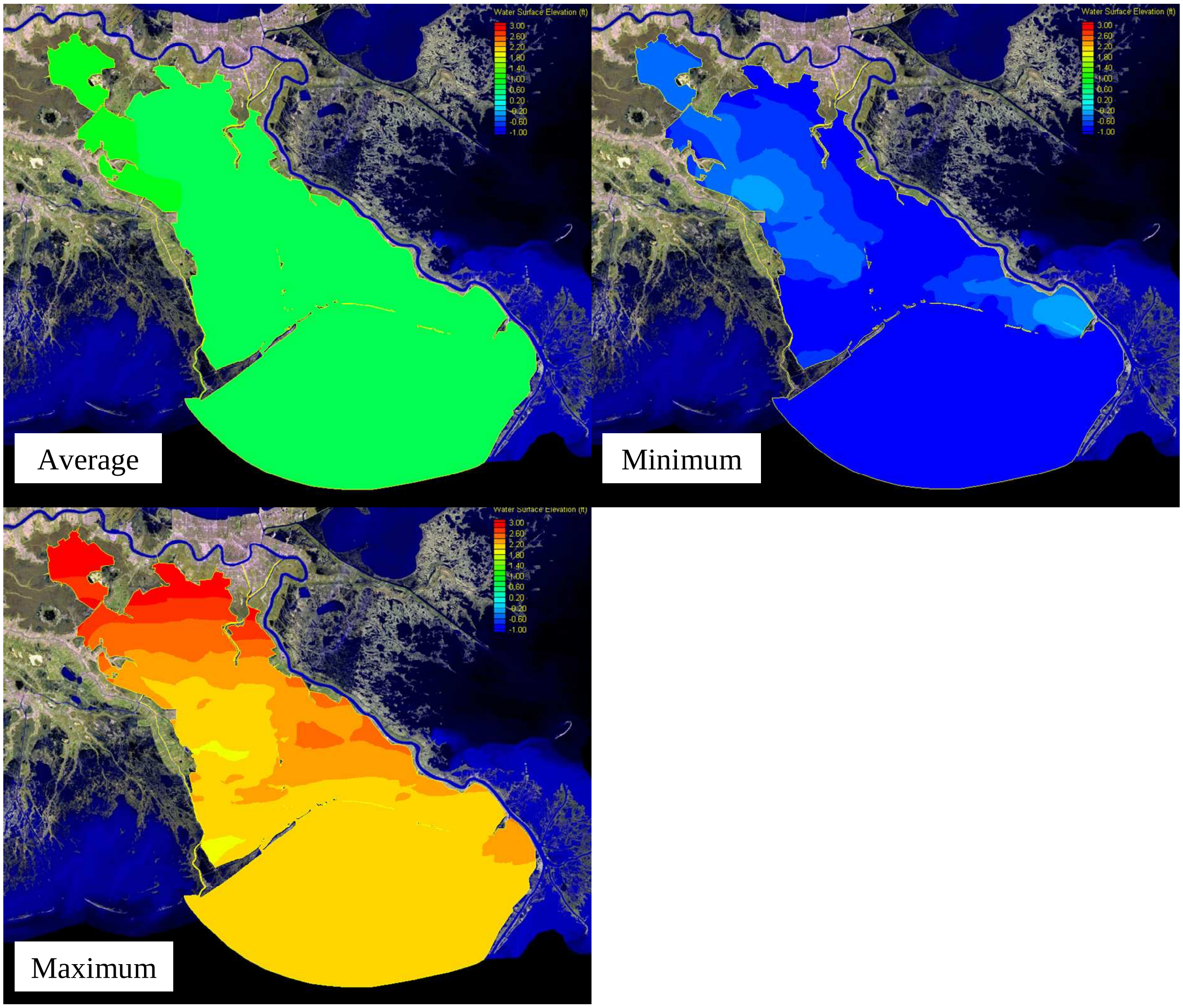


Figure 4.19-1: Semi-Annual Water Surface Elevation Results - EXCO

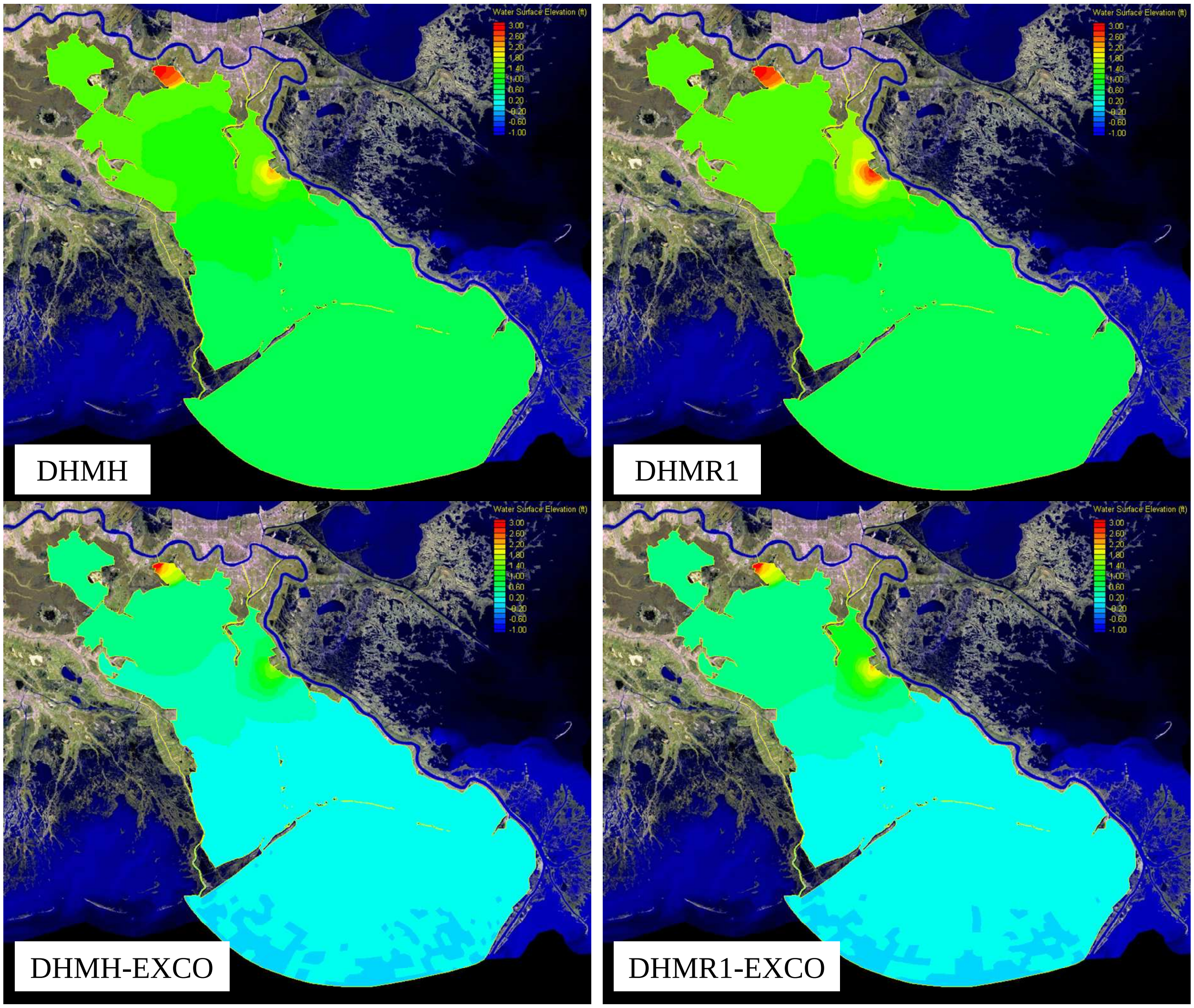


Figure 4.19-2: Semi-Annual Averaged Water Surface Elevation – DHMH & DHMR1

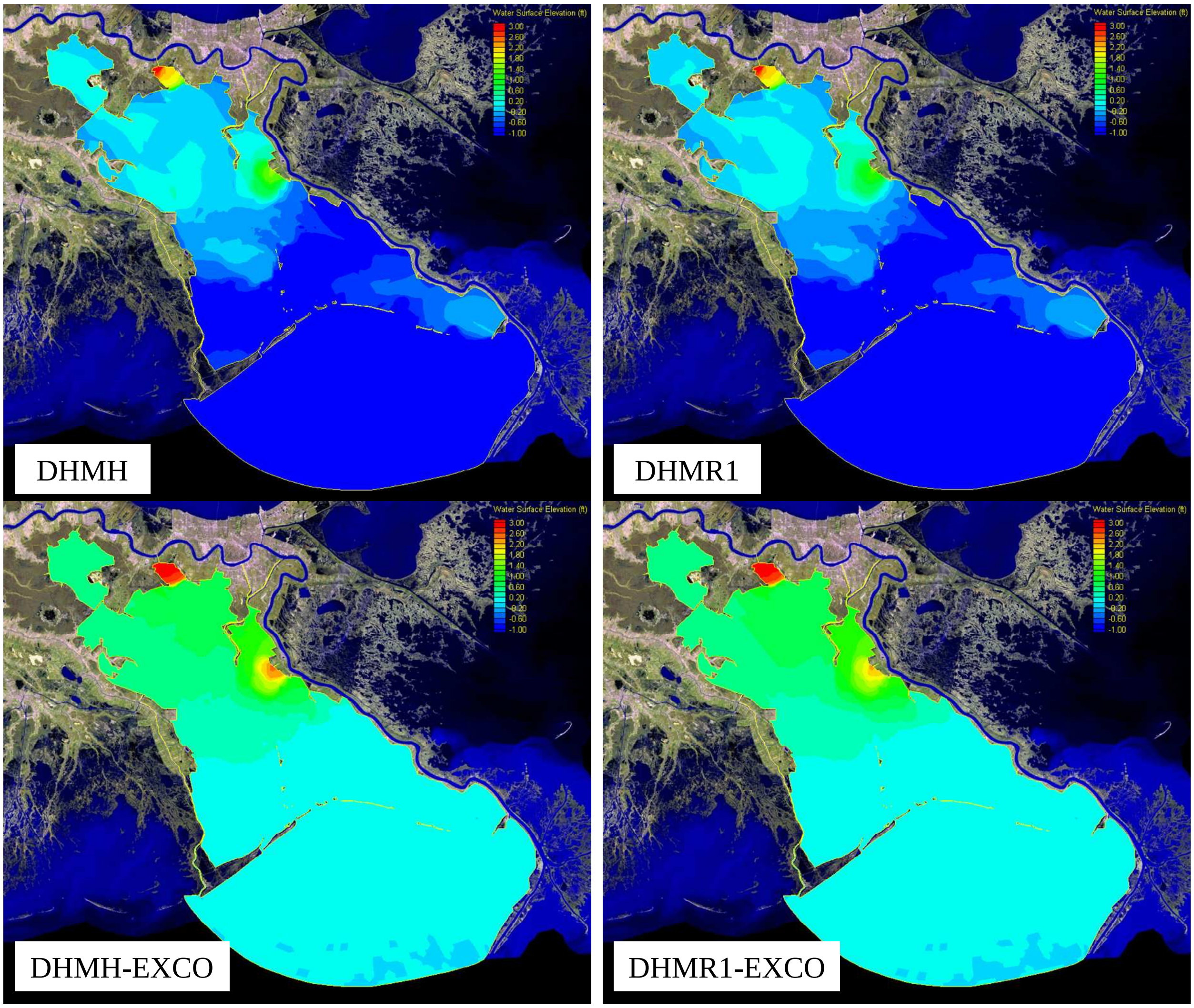


Figure 4.19-3: Semi-Annual Minimum Water Surface Elevation – DHMH & DHMR1

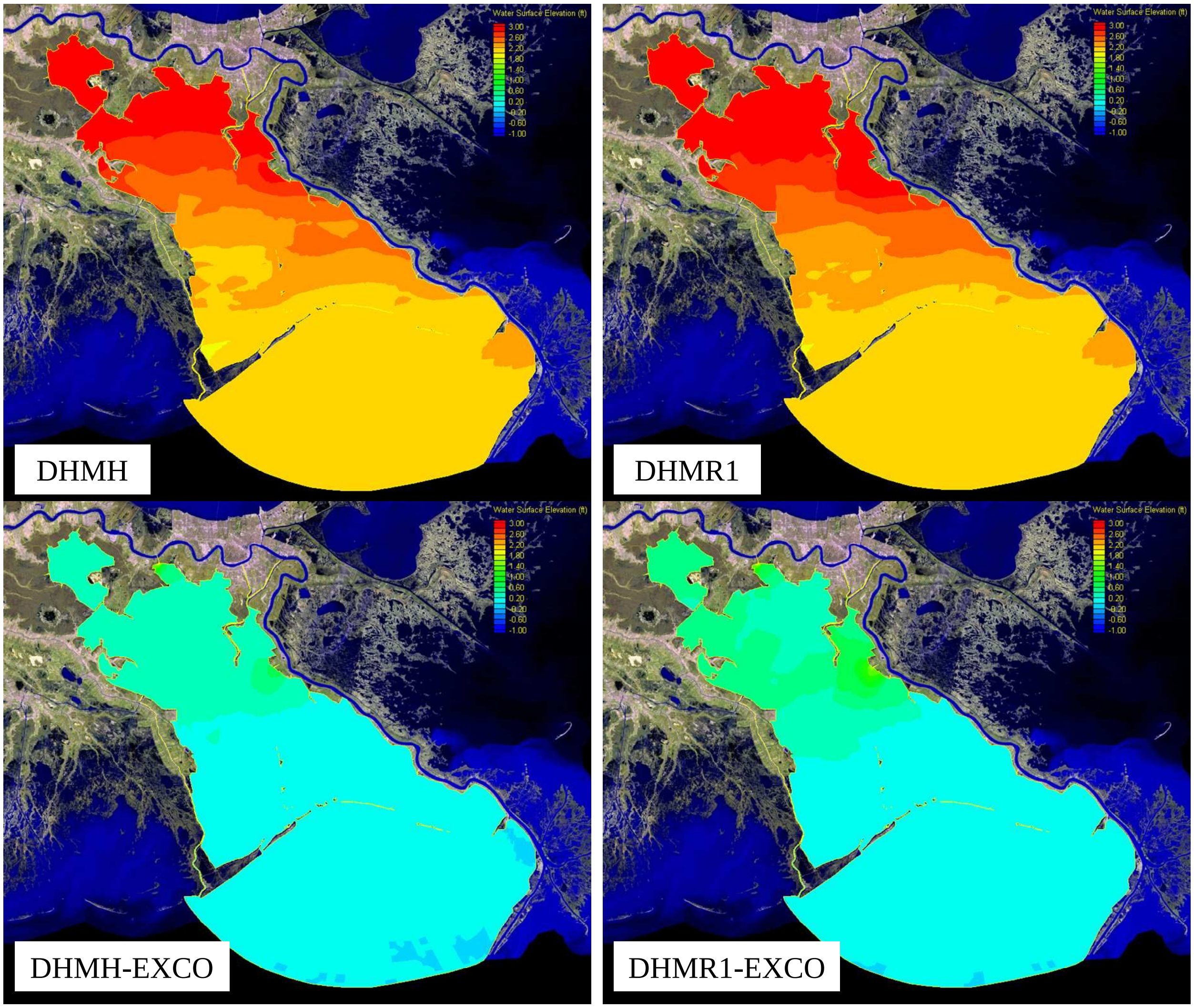


Figure 4.19-4: Semi-Annual Maximum Water Surface Elevation – DHMH & DHMR1

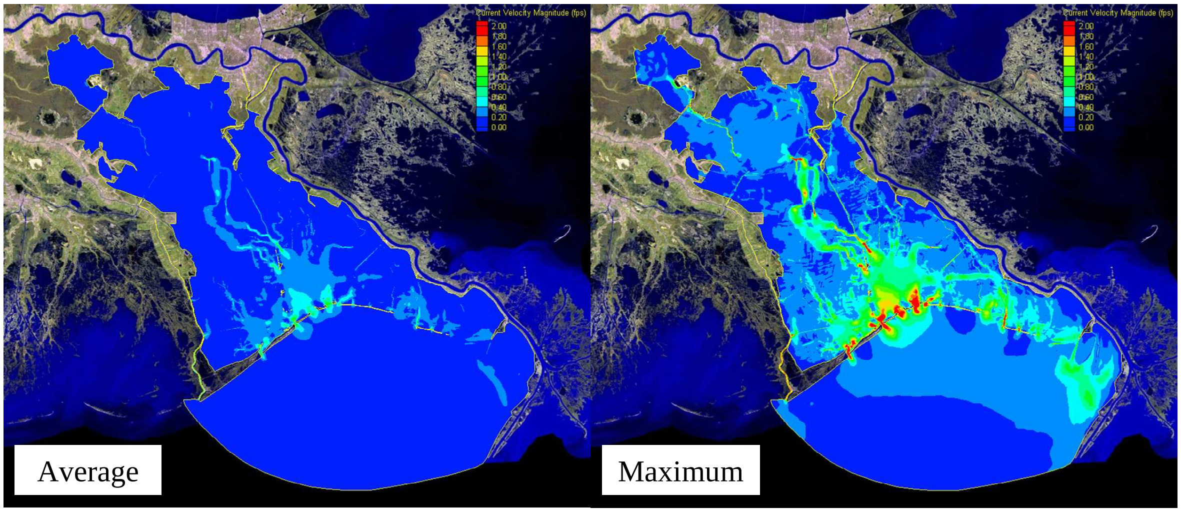


Figure 4.19-5: Semi-Annual Current Velocity Magnitude – EXCO

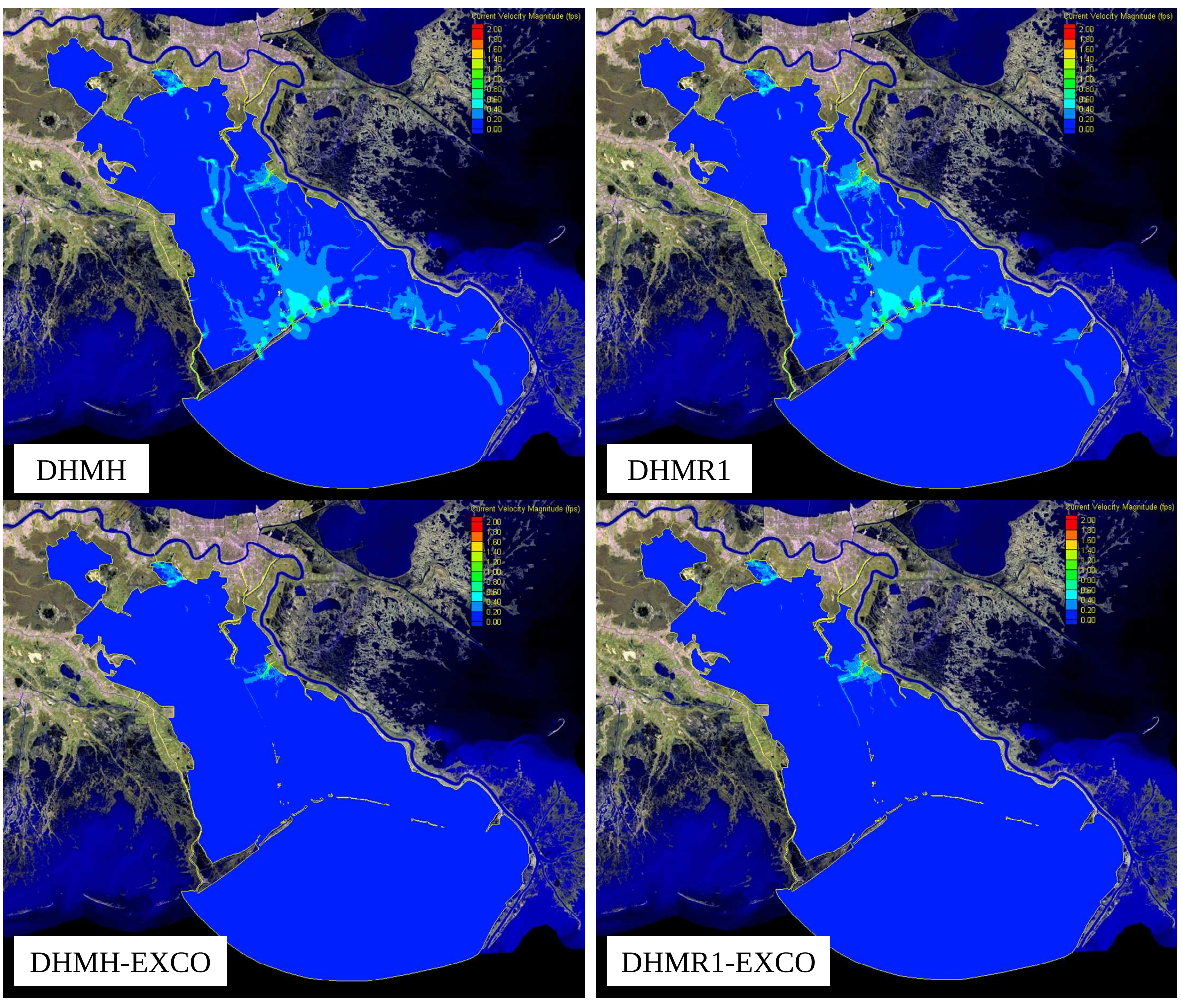


Figure 4.19-6: Semi-Annual Averaged Current Velocity Magnitude – DHMH & DHMR1

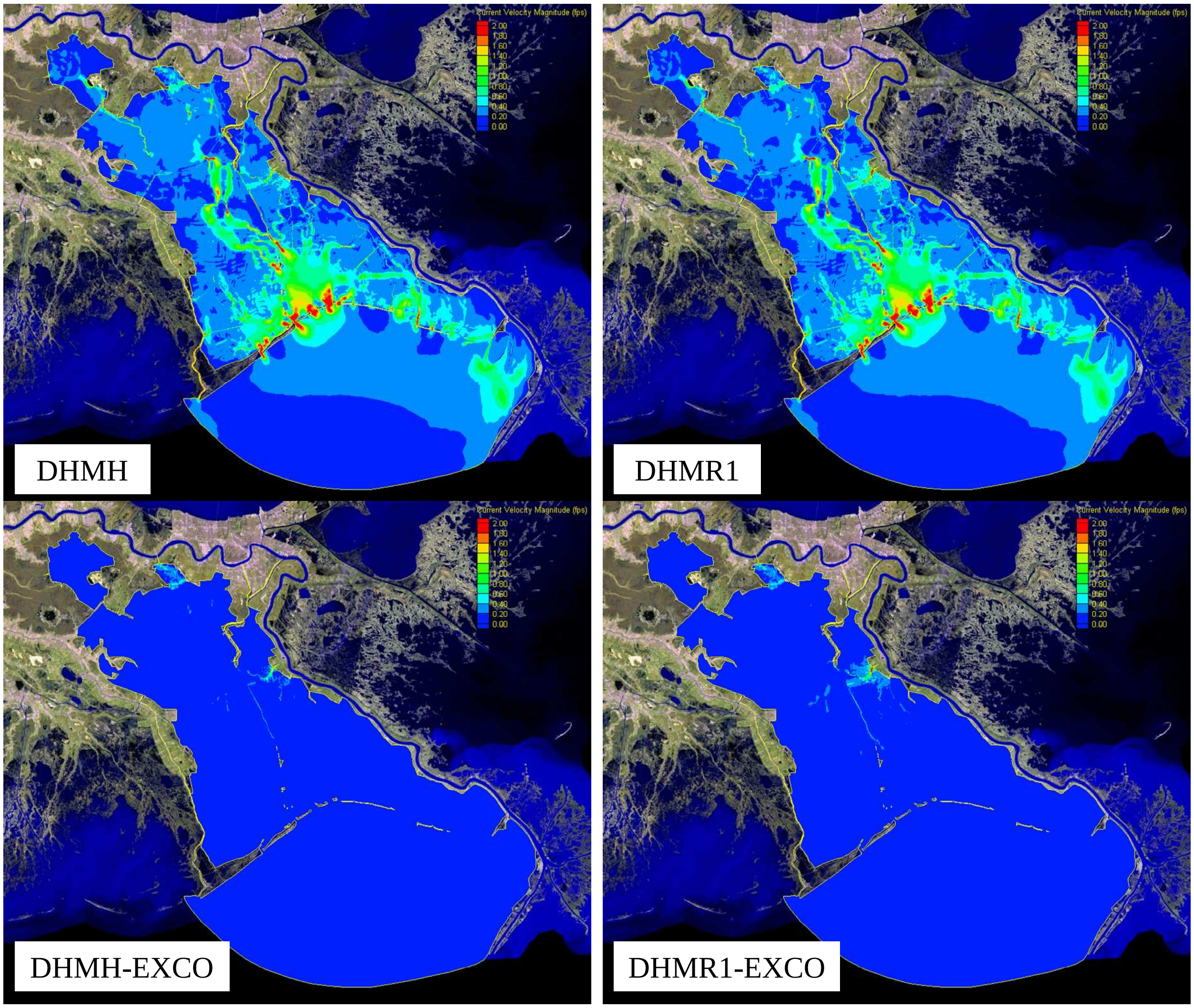


Figure 4.19-7: Semi-Annual Maximum Current Velocity Magnitude – DHMH & DHMR1

In addition to the above map demonstration of the hydrodynamic effects of the diversions, the results from a total of 17 locations (Figure 4.19-8) across the basin were also extracted from the RMA2 solution files to investigate different diversion combination effects (16 run cases) to different regions of the basin. The annual average, minimum and maximum values were calculated as well as the semi-annual ones. The results are included in Appendix W for each location. Locations above P7 show larger differences in water surface elevation changes than locations below P7. Locations P7, P12, P13 along Barataria Waterway and P8, P11 have greater current velocity differences between the runs.

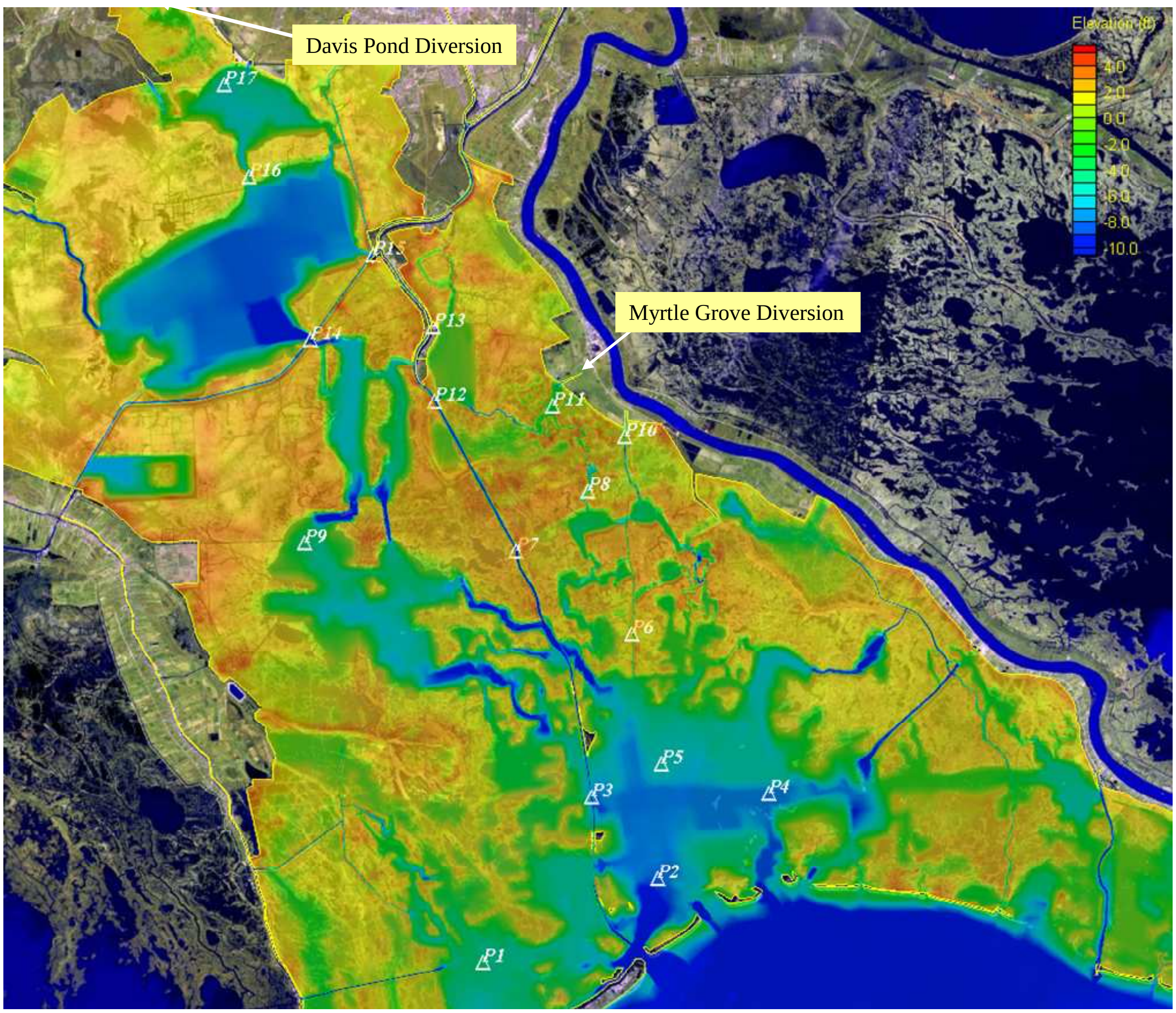


Figure 4.19-8: Location Map for Hydrodynamics Result Demonstrations

5. CONCLUSIONS & RECOMMENDATIONS

5.1 CONCLUSIONS

Analyses and review of the alternative modeling results lead to the following conclusions:

- The impacts on salinity levels in the Barataria Basin from the Myrtle Grove project depend on the diversion regimes at Davis Pond. The effects of the Myrtle Grove project are reduced under higher Davis Pond diversion scenarios.

- The Myrtle Grove project under low diversion has negligible impact on salinity levels in the Barataria Basin regardless of the Davis Pond Diversion operational level.

- High Myrtle Grove diversions could reduce annual average salinity levels over 6 ppt depending upon the magnitude of diversions at Davis Pond while medium Myrtle Grove diversions would only reduce the annual average salinity by less than 4 ppt.

- The high Myrtle Grove diversion scenario would push the annual 5 ppt and 15 ppt salinity level contours twice as far southward as the medium Myrtle Grove diversion case; regardless of the magnitude of the different Davis Pond diversion.

- On a semi-annual (December – May) basis, the R1 and double-high Myrtle Grove diversion scenarios push the 15 ppt salinity line to near the backside of the barrier islands except in the immediate vicinity of the passes, and the far eastern section of the basin.

- From a hydrodynamics point of view, on average, the larger diversions from Myrtle Grove and Davis Pond cause significant water surface elevation and current magnitude increases in the region adjacent to the sites.

5.2 RECOMMENDATIONS

Analyses and review of the alternative modeling results lead to the following recommendations:

- The Low Myrtle Grove diversion scenario is not an effective option to reduce salinity levels in the Barataria Basin and should not be considered further.

- The Medium Myrtle Grove scenario only has minimal effects on salinity levels and may not be cost effective.

- The High Myrtle Grove diversion scenario is effective at reducing salinity levels, albeit less so when higher diversions occur at Davis Pond.

- Higher diversions such as the R1 and double-high scenarios should be given further consideration due to their significant potential impacts on reducing salinity levels throughout the Barataria Basin.

- The Myrtle Grove diversions do not significantly impact areas southeast of Port Sulphur, and thus additional large diversions in the vicinity of Port Sulphur, Empire and Fort Jackson would be necessary to reduce salinities in this area.

- Further investigation is warranted to determine if the increases in water levels and current velocities results from the higher diversion are within acceptable limits, and /or what operational restrictions may be required if they are not acceptable.

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